Milk, Marias, and St. Mary Monitoring: Developing a Long-term Rotating Basin Wetland Assessment and Monitoring Strategy for Montana

Prepared for:

U. S. Environmental Protection Agency

Prepared by:

Catherine McIntyre, Karen Newlon, Linda Vance, and Meghan Burns

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Executive Summary

Wetlands are important landscape features that provide critical ecosystem services. Properly functioning wetlands retain sediment, attenuate floods, recharge groundwater, and cycle nutrients. They are particularly important in the arid West, where only a small fraction of the landscape supports wetlands. Although the passage of the Clean Water Act (CWA) in 1972 initiated federal regulations to protect wetlands, the ambient condition of wetlands continues to be degraded nationwide (National Research Council 2001). Under Section 305(b) of the CWA, all waters of the United States (including wetlands) must be monitored and assessed every two years.

To understand the condition of wetlands and riparian areas in Montana, the Montana Natural Heritage Program (MTNHP) conducts ecological integrity assessments (EIA) of wetlands and riparian areas in Montana. This report describes the MTNHP pilot project conducted as an initial step in developing a statewide rotating-basin assessment and monitoring strategy. The primary objective of the pilot project was to conduct Level 1-2-3 assessments, describe wetland condition, and identify potential anthropogenic stressors in the Milk, Marias, and St. Mary's watersheds in Montana. The target population for assessments was palustrine emergent, scrub-shrub, and forested wetlands.

We used National Wetland Inventory (NWI) polygons mapped from 1980's aerial photography to generate a pool of potential sample sites (i.e., the sample frame) for random site selection. The survey design followed a Generalized Random Tessellation Stratified (GRTS) procedure for discrete objects with reverse hierarchical randomization. This approach accounts for the spatial patterning inherent in ecological systems.

We conducted a Level 1 landscape analysis to characterize potential landscape level disturbances at three spatial scales (100, 300, and 1,000 meters) around the wetland perimeter. The Level 1 landscape analysis also included landscape profiles using 161,003 NWI palustrine wetland polygons and ancillary data sources to summarize these and other attributes at the fourth, fifth, and sixth code hydrologic unit levels.

We performed Level 2 rapid wetland assessments at 123 sites selected for field data collection. Field ecologists used the Montana EIA form to assess wetland condition for all wetland types within the project area. The EIA approach uses a set of ecological attributes that reflect both the structure and function of the wetland to assess ambient condition. Each ecological attribute contains one or more indicators to represent the status or trend of the attribute. These indicators are measured by metrics that include narrative ratings scaled along a gradient of wetland condition status. Each metric consists of three to five narrative statements that are assigned along an ordinal scale value. Higher numbers correspond with increasing levels of disturbance. Each metric rating is summarized into an overall attribute score for five attributes: 1) Landscape Context; 2) Relative Patch Size; 3) Biotic; 4) Physicochemical; and 5) Hydrology. The ratings for these five attributes are then combined to produce an overall EIA condition score.
The MTNHP EIA method uses vegetation as an intensive biological measure to assess wetland condition. Intensive Level 3 vegetation data were collected at 44 of the Level 2 sites using a 20 m x 50 m relevé plot. Level 3 vegetation data were used to conduct a Floristic Quality Assessment (FQA).

The Level 1 landscape analysis showed little variability at all three spatial scales. This is due, in part, to the homogeneity of the landscape within the project area. The dominant land uses in this part of Montana are dry land farming and livestock grazing, and much of the area is intersected by local dirt roads. With so little variability in the landscape, the landscape level analysis did not provide a reliable assessment of wetland condition. Wetland profile results indicated that 81% of the wetlands within the project area are palustrine emergent wetlands with either temporary or seasonal water regimes. Approximately 101, 400 acres of depressional wetlands occur within the project area. Three watersheds had a greater number of altered wetlands than unaltered wetlands.

Results for the Level 2 rapid assessments indicate that among depressional wetlands, Great Plains Prairie Potholes and Great Plains Saline Depressions are in better condition than either Great Plains Open or Closed Depressions. Results for open and closed depression wetlands indicate that these systems are highly susceptible to human disturbances. Northwestern Great Plains Riparian systems also had more sites ranked as severely altered, suggesting that these systems need more focused protection.

Our Level 3 results indicate that most of the wetlands assessed are dominated by species that can tolerate moderate disturbance as demonstrated by the cover-weighted mean c-values ranging from four to six. In addition, lower adjusted FQI values indicate that most of the assessed sites are dominated by plants that are frequently found in disturbed sites.

The dominant human disturbances observed and affecting wetland condition in the project area include roads, conversion of temporary and seasonal wetlands to dryland farming and stock ponds, and soil and vegetation disturbance associated with heavy livestock grazing. Effects of human induced disturbance may covary with natural disturbances including drought. Drought may affect wetland condition more than either local or landscape level human disturbances.

There are several confounding issues with assessing wetlands in this region. Depressional wetlands are dynamic systems where wet-drought cycles influence the ecological communities present. Therefore, our assessments are just a snapshot of the ecological condition of the wetland at that stage within its wet-drought cycle. Because assessment results may change depending on the wet-drought cycle it is important to assess reference wetlands over a long period of time to establish a gradient of known conditions for wetlands with different water regimes.

Both the Level 1 and Level 2 analysis need further calibration and refinement based on intensive Level 3 assessments. Additional Level 3 assessments should be developed to help in the further validation of our methods. Based on this pilot project, the MTNHP will continue to develop indicators and metrics for a long-term integrated, statewide, multi-jurisdictional wetland condition monitoring and assessment strategy based on EPA's recommended elements.

Acknowledgements

This project was funded by an Environmental Protection Agency Region 8 Wetland Program Development Grant. We would like to thank Toney Ott and Jill Minter of EPA Region 8 for their support and commitment to wetland assessment and monitoring in our region.

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Any errors or omissions in the report are entirely the responsibility of the authors.

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Introduction

Wetlands are important landscape features that provide critical ecosystem services. Properly functioning wetlands retain sediment, attenuate floods, recharge groundwater, and cycle nutrients. These critical biological functions also have the potential for significant socioeconomic impacts. These functions are particularly important in the arid West, where only a small fraction of the landscape supports wetlands. Historically, nearly 25% of Montana's wetlands have been lost since 1780 (Dahl 1990, Jones 2003). Although the passage of the Clean Water Act (CWA) in 1972 initiated federal regulations to protect wetlands, the ambient condition of wetlands continues to be degraded nationwide (National Research Council 2001). Under Section 305(b) of the CWA, all waters of the Unites States (including wetlands) must be monitored and assessed every two years. Reporting on the ambient condition of wetlands is necessary to determine if management and restoration practices are succeeding (Kentula 2007).

The CWA requirement for States to report on the condition of State waters and wetlands underscores the need for a comprehensive wetland monitoring and assessment program in Montana. To adequately characterize wetland condition and prioritize conservation, restoration and management, wetland assessments should be conducted within a watershed context (National Research Council 2001, White and Fennessy 2005, Brooks et al. 2006) and at multiple spatial scales (Brooks et al. 2004). The Ecological Integrity Assessment (EIA) Framework provides a scientifically sound methodology for these types of biological and ecological resource assessments (Kentula 2007). "Ecological integrity" is the ability of an ecosystem to support and maintain a full suite of organisms with species composition, diversity, and function comparable to systems in an undisturbed state (Karr and Dudley, 1981). It varies along a continuum of anthropogenic influences or disturbances. At one end of this continuum are pristine or minimally impacted systems, supporting the full complement of ecological processes. With increasing human disturbance, the condition of these systems may decline (Karr and Chu 1999). An EIA assessment framework uses multi-metric indices to evaluate the ecological integrity of wetlands at multiple spatial scales. By integrating landscape level land-use data and site-level condition assessments, the EIA framework provides comprehensive, watershed level wetland integrity evaluations, and meets regional and site specific information needs.

The Montana Natural Heritage Program (MTNHP) conducts ecological integrity assessments for wetlands in Montana using the EIA framework, augmented with methods developed by ecologists from other state Natural Heritage programs and the NatureServe network (Faber-Langendoen et al. 2006, 2008; Rocchio 2006a, 2006b). The MTNHP multi-scale EIA follows the three-tier approach recommended by the U.S. Environmental Protection Agency (EPA). The first tier is a Level 1 GIS-based landscape assessment using available digital data to provide information on watershed condition. Its primary metrics are based on anthropogenic stressors such as roads, resource extraction, and land conversion from native vegetation to agriculture or residential development. The Level 1 assessment also includes wetland profiles summarizing general information on wetland abundance, type, extent, and function within a given watershed (Johnson 2005). The second tier (Level 2) is a rapid field-based assessment using a suite of metrics to record the general condition of individual wetlands. These metrics evaluate various indicators of landscape context, biotic, hydrologic, and physico-chemical condition. Finally, a detailed quantitative Level 3 field assessment is conducted and used to calculate site-specific indices of biological integrity (refer to Appendix B for field form). Using the three-tiered approach, information from each level is used to validate the results of the other levels (Kentula 2007). The multi-tiered approach allows the ambient condition of wetlands to be monitored over time and spatially referenced. Management decisions and actions can then be prioritized so that sites in good condition can be protected and sites that have been impacted can be selected for restoration.

This report describes the MTNHP pilot project conducted as an initial step in developing a statewide rotating- basin assessment and monitoring strategy. The primary objective of the pilot project was to conduct Level 1-2-3 assessments, describe wetland condition, and identify potential anthropogenic stressors in the Milk, Marias, and St. Mary watersheds in Montana. These watersheds were selected because of their biological and socioeconomic importance and the availability of complete digital wetland mapping from the National Wetland Inventory (NWI).

Study Area

Physical Setting

The project area is located in north central Montana and includes Glacier, Liberty, Toole, Pondera, Teton, Hill, Blaine, Phillips, Chouteau, and Valley Counties. The study area extends from Glacier National Park on the Rocky Mountain Front east across the foothills and the glaciated plains. It lies within the southwestern edge of the Prairie Pothole region, an area with national and global ecological significance (Mitsch and Gosselink 2000). Unlike many significant natural areas in the U.S., the Prairie Pothole region of northern Montana is not the subject of focused state or federal protection efforts. Lands are primarily privately owned with federal and state ownership scattered throughout the watersheds. Land use is divided between livestock grazing on native prairie, dryland farming, and hay production. Three river basins were used to delineate the study area: those portions of the St. Mary and Milk River Basins that fall within Montana, and all of the Marias River (Figure 1).

Geology and Climate

The project area includes 15,794,321 acres and includes portions of four Level III ecoregions (Omernik 1987): the Canadian Rockies, the Northwestern Glaciated Plains, the Middle Rockies, and the Northwestern Great Plains. However, most of the project is within the Northwestern Glaciated Plains ecoregion (Figure 2). The western edge is rugged and forested, with outcrops of Precambrian Belt rock. Geologically, it is characterized by drift deposits, colluvium, moraines, glacially carved U-shaped valleys, kettle ponds, and poorly developed drainage networks. Elevations in this area can exceed 3,000 meters; highest elevations have lingering snow, and are mostly talus and rock. By contrast, the central and eastern portions are

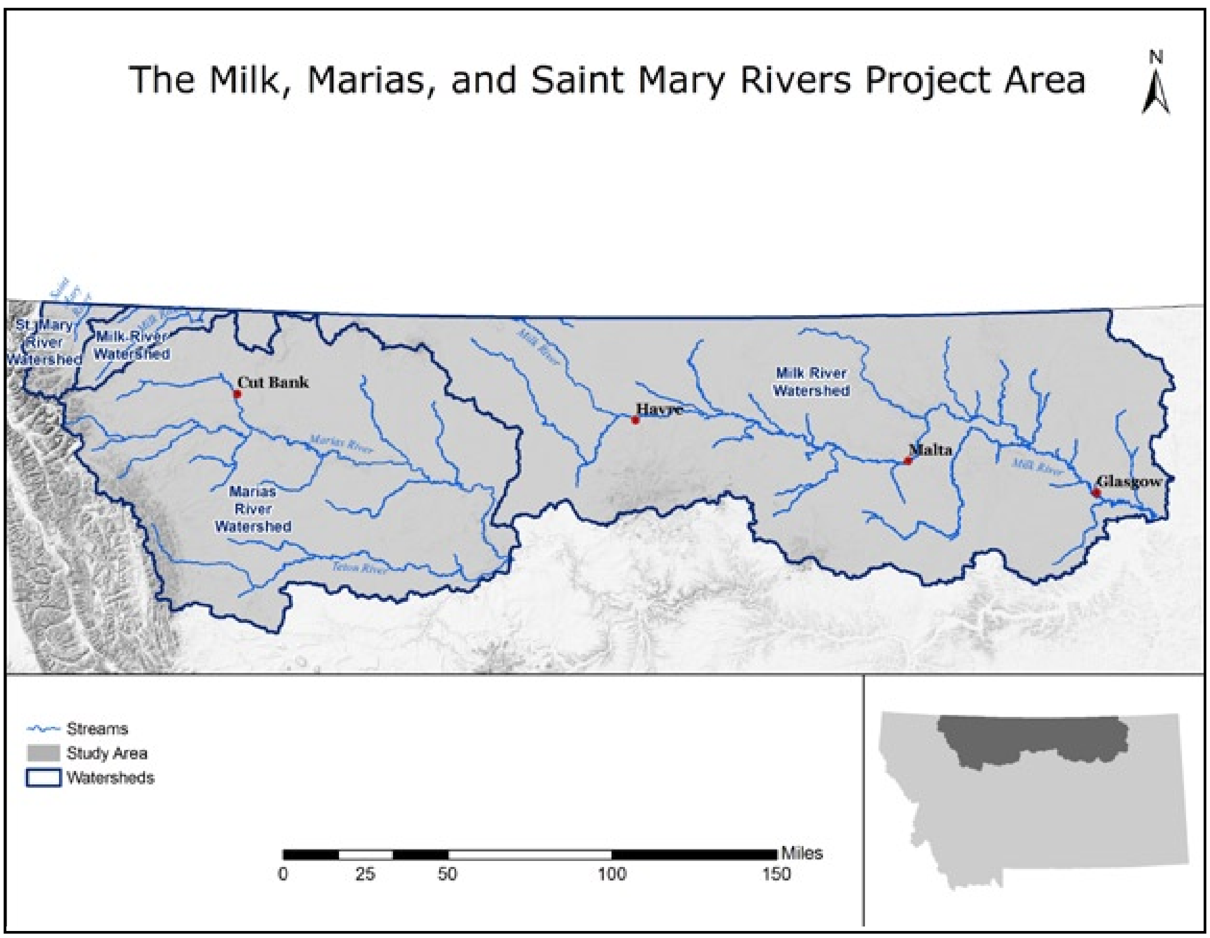

Figure 1. Watersheds included in the Milk, Marias, and Saint Mary Rivers project area.

dominated by plains, terraces, and floodplains that formed in glacial till, by gravel deposits, and by alluvium over clay shale, sandstone, and siltstone (Nesser et al. 1997). Unlike the western front, the prairie portion has minor vertical relief. Elevations along the Milk River range from 750 meters near Fresno Dam to 600 meters at Glasgow, while elevations along the Marias River range from 900 meters at Tiber Dam to 750 meters at its confluence with the Missouri River. The Northwestern Glaciated Plains ecoregion is the most westerly edge of glaciation and is dominated by both moraines and depressional wetlands carved out by the Keewatin ice sheet (Jones 2003). Glacial till, outwash, and drift up to 30 meters thick overlay the rolling terrain (Nesser et al. 1997). The most extensive geologic substrate in the study area, extending from Canada to the Missouri River, is marine-origin clay shale and shale of the Bearpaw and Claggett formations. Sandstone and sandy shale is locally common and is most abundant in the breaks along the Marias and Milk Rivers. Quaternary age alluvium fills most of the valley bottom of the Milk River.

Climate varies widely from the western to eastern parts of the study area. Relative effective annual precipitation (REAP), which is an indicator of the amount of moisture available at a given location accounting for precipitation, slope, aspect, and soil properties, ranges from over 1,524 mm (60 in) in the western portion of the project area to 406 mm (16 in) in the eastern portion (Figure 3). The climate is continental and temperate with frigid winters and warm to hot summers (McNab and Avers 1994). Mean January low temperatures ranges from -10.5°C (13.1°F) at East Glacier in the west to -14.1°C (6.7 °F) at Malta in the east. Mean July high temperatures range from 23.6 °C (74.4 °F) at East Glacier to 30.9 °C (87.7 °F) at Malta (Western Regional Climate Center 2010). Across the area, precipitation peaks in late spring or early summer with steady, soaking frontal system rains. Summer

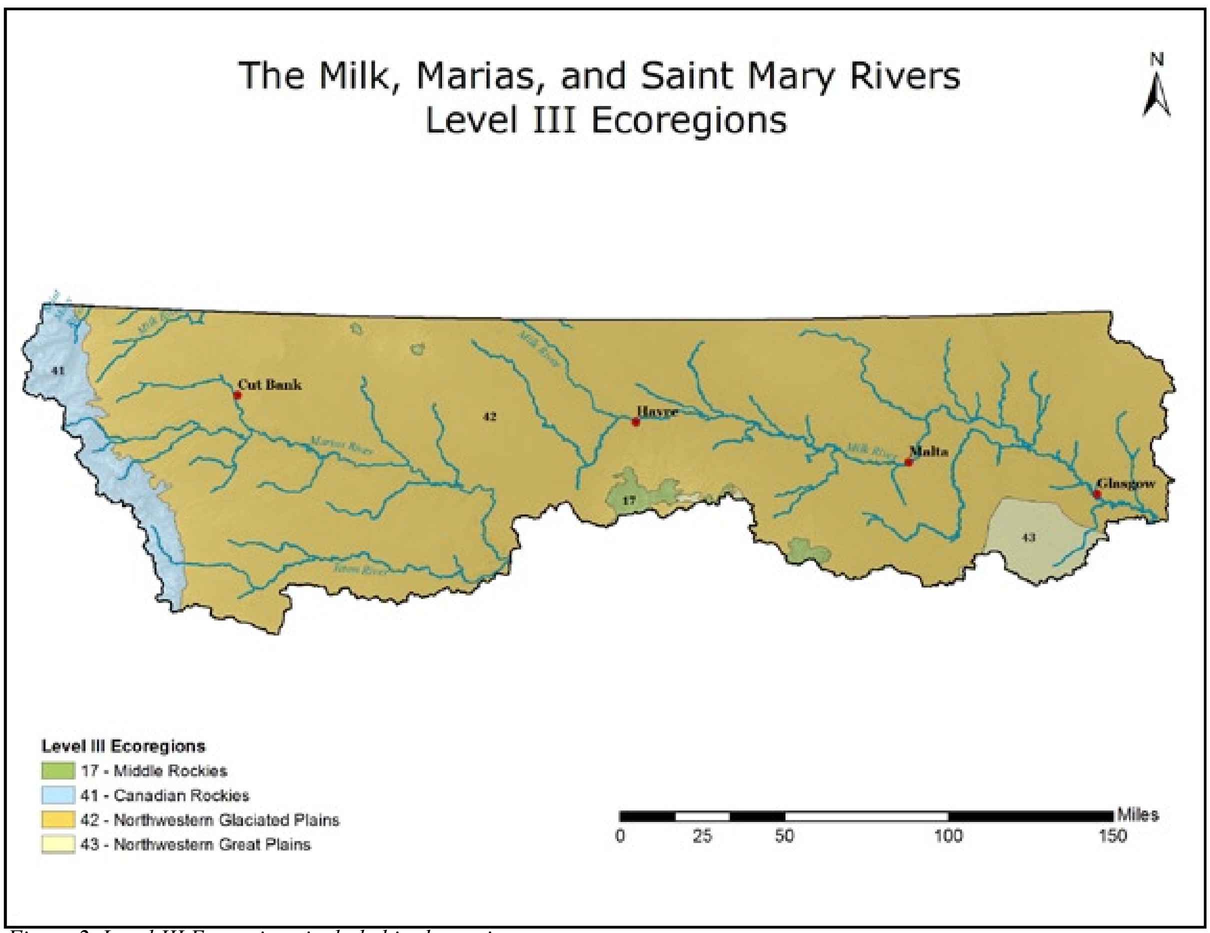

Figure 2. Level III Ecoregions included in the project area.

rainfall comes mainly from convection thunderstorms that typically deliver bursts of intense rain in scattered locations. These storms are often accompanied by large diameter hail and flash floods (Jones 2003). Where rainfall exceeds evapotranspiration, conditions are suitable for agriculture, particularly cereal grains. The growing season across the farmed areas is typically 110-130 days, with approximately 70-80% of annual precipitation falling within that period (McNab and Aver 1994).

The Milk, Marias and St. Mary Rivers originate on the Rocky Mountain Front. The Milk begins in the foothills north of Browning, Montana at the confluence of the South and Middle Fork of the Milk River. The Milk River joins the North Fork of the Milk River and flows into Fresno Reservoir, east of Havre, Montana. After flowing through a series of diversion dams below the reservoir, the Milk River joins the Missouri River 12 miles downstream of Fort Peck Dam. The Marias River begins in the foothills of the Rocky Mountains on the Blackfeet Indian Reservation at the confluence of Cut Bank, Dupuyer, and Birch Creeks and the Two Medicine River. It flows southeastward to Lake Elwell, formed by Tiber Dam. From Lake Elwell, a recreation and irrigation facility, the river flows east and south for 50 miles before entering the Missouri River at Loma.

The St. Mary River begins in Glacier National Park and flows through the Blackfeet Indian Reservation. Over 150,000 acre feet of water is diverted from the St. Mary into the North Fork of the Milk through a canal and inverted siphon. The remaining water flows into Canada and ultimately into Hudson Bay.

Tributary streams in the westernmost part of the study area are perennial or intermittent, fed by groundwater, snowmelt, and spring/summer rains. In the eastern part of the study area, except around

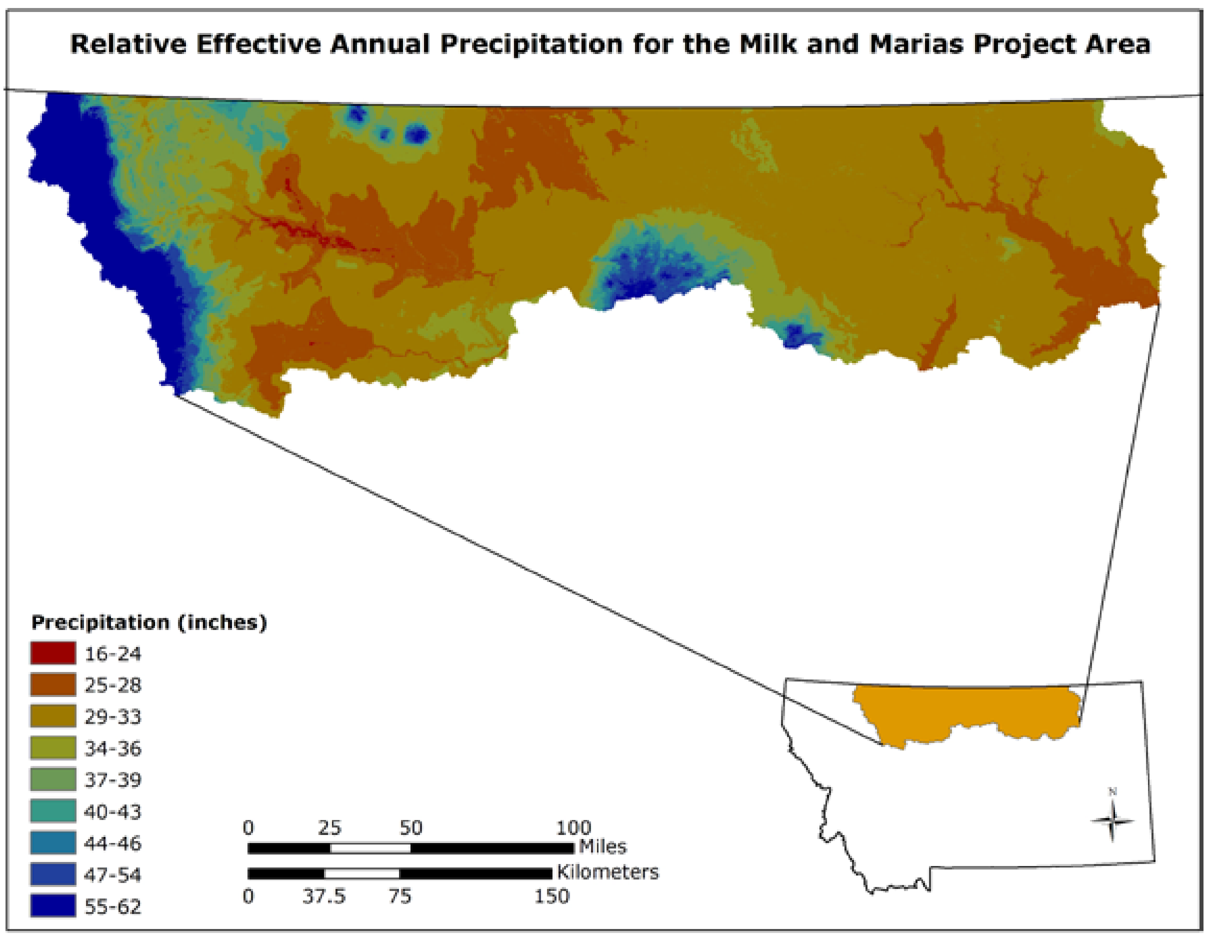

Figure 3. Map showing the relative annual precipitation (REAP) in inches for the project area.

the Bears Paw Mountains, most tributaries are intermittent or ephemeral (Vance 2009). In the east, snow depths in winter seldom exceed 3-6 inches, but wind redistributes snow to lee positions and swales, where subsequent compaction results in considerably higher moisture content than on flats. These swales may also concentrate rainfall during late spring and during summer storm events, creating ephemeral channels.

Wetland hydrology in the study area is also complex. In the western portion, and especially on the Blackfeet Reservation, there are numerous carrs and fens along the mountain to valley transition zone. The central and eastern portions are characterized by prairie potholes, open and closed depressional wetlands, saline depressions, and emergent marshes (full ecological system descriptions in Appendix A and Ecological System Field Key in Appendix B). Depressional wetlands occur in the Milk River in the area around the Bowdoin National Wildlife Refuge, often occupying old oxbows of the pre-glacial Missouri River. Prairie potholes occur across the study area, but are most densely concentrated in the area north of US Route 2, where poorly defined or nonexistent surface drainage channels are a characteristic of the rolling landscape. Fine-textured, low-permeability soils limit infiltration (Winter 1989), and small drainage basins concentrate even the small amount of surface runoff. Rainfall accumulates rapidly in potholes during spring months, especially when infiltration is hindered until after the ground thaws. Snowmelt is the primary source of water for these systems as well as springtime rains so that water levels are typically higher in the spring and early summer as opposed to later in the summer from summer rain and runoff events (Winter 1989). Depressional and prairie pothole wetlands can be temporarily, seasonally, or semipermanently flooded. Temporary wetlands typically are small shallow basins that only hold water for one to two months (Johnson et al. 2010). Seasonal wetlands tend to be larger basins that will hold water for up to two to three months (Stewart and Kantrud 1971, Johnson et al. 2010). Depressional wetlands that are clustered on the landscape are defined as wetland complexes and are often connected to one another hydrologically through both surface water and groundwater (Winter and Rosenberry 1995, Johnson et al. 2010).

Evapotranspiration appears to be the primary conduit for water loss (Shjeflo 1968). In Montana's semiarid climate, evapotranspiration will generally be much greater than precipitation during summer months. Moreover, the same clay and silt soils that limit infiltration when wet are prone to developing secondary cracks during dry months, resulting in rapid infiltration when summer rain events occur. Consequently, prairie potholes will be relatively dry throughout most years, and only hold measurable amounts of water in years when precipitation significantly exceeds average.

Although precipitation and evapotranspiration are the principal drivers of water exchange in prairie potholes, both subsurface and surface interactions can occur between individual wetlands. Subsurface flows are well-documented (reviewed by Winter 1989), and allow water retention over significant periods of time, far exceeding what would be expected if only surface inputs and evaporation are considered (Winter and Rosenberry 1995). Depending on the underlying geology and hydraulic head, individual wetlands can be recharge wetlands, discharge wetlands, or flow-through wetlands; topographic position alone is insufficient as an indicator of pothole hydrology (Leibowitz and Vining 2003). Flows can also reverse on a seasonal basis: an individual pothole can be a discharge wetland in the spring, receiving ground water from uplands, and then become a recharge wetland in summer as evapotranspiration creates a groundwater sink (Winter 1989).

Surface connectivity occurs among some prairie potholes, with topographically lower wetlands receiving inputs from upslope wetlands (Winter 1989, Winter and Rosenberry 1998). In certain areas, surface water connections may occur sporadically when periods of intense rain result in potholes overflowing and forming temporary connections to adjacent ones. Leibowitz and Vining (2003) have coined the term "temporal connectivity" to refer to this phenomenon, and suggest that it be considered not as a presence/absence occurrence, but rather as a probability event. However, they note that

temporal connectivity is much more likely to exist in the eastern part of the prairie pothole region, which is characterized by relatively flat terrain. In the more rolling prairie landscapes and semiarid climate of the study area, the probability of this temporal surface water connectivity is likely to be distributed over fewer wetlands and a longer period of time. When surface water connections occur, however, they can have an ecologically controlling effect. Surface water flow from larger, upslope wetlands can increase electrical conductivity and salinity (Leibowitz and Vining 2003), both of which are factors controlling the distribution of plants (Stewart and Kantrud 1971) and invertebrates (Euliss et al. 2002) in prairie potholes. The hydrologic functions at a given wetland can sometimes be determined in the field by salinity, or can be identified by vegetation types. Potholes with high salinity tend to be groundwater discharge wetlands. Potholes that are classified as temporarily flooded in the NWI mapping tend to recharge groundwater, while those characterized as seasonally flooded are generally either flow-through or groundwater recharge. Semi-permanently flooded potholes can have either groundwater discharge or flow-through functions (Euliss et al. 2002).

Vegetation and Ecological Processes

Riparian habitats along the Milk, and to a lesser extent, the Marias, are characterized by the oxbow marshes, shrub-dominated terraces, and cottonwood gallery forests generally associated with floodplains. The St. Mary, at higher elevations, is a high gradient river with less floodplain development, and riparian habitats are more characteristically mixed woodland and shrubland. Three species of cottonwood occur: plains cottonwood (*Populus deltoides*), narrowleaf cottonwood (*P. angustifolia*), and black cottonwood (*P. balsamifera* ssp. *trichocarpa*). In the western portion of the project area, black cottonwood is the dominant riparian tree. Plains cottonwood is the most common species overall, and dominates most stands, although narrowleaf cottonwood is also common.

Central and eastern floodplains can be lush if they are still within reach of high flows. More mesic stands support a well-developed and diverse shrub and small tree layer including boxelder (*Acer negundo*), peachleaf willow (*Salix amygdaloides*), yellow willow (*S. lutea*), red-osier dogwood (*Cornus sericea*), chokecherry (*Prunus virginiana*), western snowberry (*Symphoricarpos occidentalis*), Wood's rose (*Rosa woodsii*), and silver buffaloberry (*Shepherdia argentea*). Drier stands on terraces often have no shrub component at all or a less diverse shrub layer dominated by western snowberry or Wood's rose. The native grasses that once characterized these stands, such as western wheatgrass (*Pascopyrum smithii*) and thickspike wheatgrass (*Elymus lanceolatus*), have now largely been replaced by exotic pasture grasses, primarily Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*). Grazing has also greatly altered these communities in places by shifting shrub composition to favor less palatable species, such as rose and snowberry.

Tributaries generally have small, narrow floodplains with discontinuous bands of cottonwood. In the central and eastern parts of the study area, these streams usually have broader terraces with silver sage (*Artemisia cana*) / western wheatgrass communities. Saltgrass (*Distichlis spicata*), threesquare bulrush (*Schoenoplectus pungens*), and black greasewood (*Sarcobatus vermiculatus*) are common along more alkaline streams. In general, small, ephemeral streams have greater year-to-year hydrologic variability than larger rivers, so cottonwood regeneration is highly episodic.

Wetland vegetation is highly variable, depending on wetland type and location. Along the Rocky Mountain Front, fens occur at higher elevations as a mosaic of herbaceous and woody plant communities. In herbaceous communities, several plant associations are dominated by sedges (*Carex* sp.) and spikerushes (*Eleocharis* sp.). Bryophyte diversity is generally high and includes sphagnum (*Sphagnum* sp.). Shrub-dominated carrs are typically composed of willow (*Salix* sp.) and dwarf birch (*Betula nana*). The surrounding landscape may be ringed with other wetland systems: fens often grade into marshes, wet meadows or riparian shrublands, and can be surrounded by conifer swamps or wet to mesic coniferous forests.

Marshes occur in and adjacent to ponds and prairie potholes, as fringes around lakes or oxbows, and along slow-flowing streams and rivers. Marshes are classified as either seasonal or semipermanent based on the dominant vegetation found in the deepest portion of the wetland, as vegetation is representative of the hydroperiod. Semipermanent wetlands are continually inundated with water depths up to 2 meters (6.5 feet). Dominant vegetation includes common threesquare, Nebraska sedge (*Carex nebrascensis*), broadleaf cattail (*Typha latifolia*), and hardstem bulrush (*Schoenoplectus acutus*). Alkaline marsh communities are usually dominated by alkali bulrush (*S. maritimus*), fresh water cordgrass (*Spartina pectinata*), and seashore saltgrass.

Depressional wetlands are dynamic systems that developed under climatic conditions where wet-drought cycles in Montana influence the ecological communities in these systems (Hansen et al., 1995). Vegetation communities within these systems are characterized as concentric zones around the deeper portion of the wetland. These bands of vegetation communities follow a hydrologic gradient from low prairie, to wet meadow, then to emergent marsh or open water in the deeper portion of the wetland. The number of zones is dependent on the wet-drought cycle where during drought years there may only be one vegetative zone. Flooding, drawdown and the eventual exposure of mud flats drive the water-level vegetation cycle. Seeds from annuals and perennials germinate and cover exposed mud flats, but when precipitation floods the depressions the annuals drown and the perennials survive. Over a series of years the perennials dominate. The drawdown to mudflats is necessary so that emergent vegetation can become reestablished.

Closed depressions usually feature a drawdown zone dominated by western wheatgrass and foxtail barley (*Hordeum jubatum*). Povertyweed (*Iva axillaris*) and willow dock (*Rumex salicifolius*) occupy the broad, low gradient basins that are shallowly inundated in the spring and draw down every year to reveal bottoms of gray bentonite. Common spikerush (*Eleocharis palustris*) occurs within the drawdown area where there is more organic matter in the substrate. Hardstem bulrush typifies closed depressions sufficiently deep to remain permanently inundated during most years.

Open depression wetlands often have submerged aquatic plants in the open water zone including common hornwort (*Ceratophyllum demersum*), short spikewater milfoil (*Myriophyllum sibiricum*), and horned pondweed (*Zannichellia palustris*) as well as floating-leaved plants including pondweeds (*Stuckenia* and *Potamogeton* sp.), white water crowfoot (*Ranunculus aquatilis*) and arrowheads (*Sagittaria* sp.). The central marsh zone is typically dominated by hardstem bulrush, but softstem bulrush (*Schoenoplectus tabernaemontani*), common threesquare and alkali bulrush, often co-dominate. Also found in the marsh zone are cattails, water knotweed (*Polygonum amphibium*), and hemlock water parsnip (*Sium suave*). The seasonally flooded zones are typically dominated by graminoids including common spikerush, needle spikerush (*Eleocharis acicularis*), American sloughgrass (*Beckmannia syzigachne*), wheat sedge (*Carex atherodes*), foxtail barley, shortawn foxtail (*Alopecurus aequalis*), and water foxtail (*A. geniculatus*). Open depressional systems are often bordered by wet prairie zones characterized by species such as slimstem reedgrass (*Calamagrostis stricta*), bluejoint (*C. canadensis*), clustered field sedge (*Carex praegracilis*) and fowl bluegrass (*Poa palustris*). Open depressions with more alkaline or saline water and soil chemistry will typically be bordered by species such as saltgrass, western wheatgrass, and freshwater cordgrass. Sites that have been moderately grazed often have an increase in Baltic rush (*Juncus balticus*), knotted rush (*J. nodosus*), foxtail barley, and American sloughgrass. In semi-permanent open depressional systems, the drawdown zone is typically dominated by beaked sedge (*Carex utriculata*) water sedge (*C. aquatilis*), and Nebraska sedge.

Saline depressional wetlands are similar, but tend to have brackish water and high salinity, attributed to high evaporation and the accumulation of minerals dissolved in the water. Species that typify this system are salt-tolerant and halophytic graminoids such as alkali bulrush, common three square, inland saltgrass, Nuttall's alkali grass (*Puccinellia nuttalliana*), foxtail barley, red swampfire (*Salicornia*

rubra) and freshwater cordgrass, and shrubs such as black greasewood.

Prairie potholes occur in shallow depressions that were created when ice from receding glaciers were abandoned and melted creating small complexes of depressions. These types of wetlands are ephemeral with standing water only lasting for a few weeks in the spring to early summer but water levels can vary due to seasonal and inter-annual variations (Jones 2003, Van der Kamp et al. 1999). Vegetation in prairie potholes also occurs in concentric zones that follow the hydrologic gradient of the wetland including low prairie, wet meadow, and shallow marsh (Stewart and Kantrud 1971). The types of vegetation that occur in these wetlands are influenced by water duration, salinity, and the surrounding land use (DeKeyser et al. 2003). Dominant vegetation includes spikerush, foxtail barley, and western wheatgrass.

The native upland vegetation ranges from the cool-season perennial bunch grasses and forbs that dominate the Rocky Mountain Front foothills to the mix of short- and mid-grass prairie communities that intermix with shrub steppe in central and eastern portions. Grasses have the greatest canopy cover, and western wheatgrass is usually dominant. Other species include thickspike wheatgrass (*Elymus lanceolatus*), green needlegrass (*Nassella viridula*), blue grama (*Bouteloua gracilis*), and needle and thread (*Hesperostipa comata*). Near the Canadian border in north-central Montana, this system grades into rough fescue (*Festuca campestris*) and Idaho fescue (*F. idahoensis*) grasslands. Steppe vegetation is the result of a semi-arid continental climate where the highly variable precipitation favors shallow-rooted herbaceous perennial grasses and deep-rooted shrubs over forests or woodlands. Shrub steppe vegetation is characterized by open stands of silver sagebrush or Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) over an herbaceous layer dominated by western wheatgrass, blue grama or needle-and-thread. The co-occurrence of short- and mid-grass prairies is also due to climatic variability. Shorter, drought-resistant grasses such as blue grama increase in abundance during times of drought. Mid-grasses, such as the rhizomatous western wheatgrass and the bunch-forming prairie junegrass (*Koeleria macrantha*) and needle-and-thread, increase under more favorable moisture conditions.

Animal Communities

Wetlands, particularly prairie potholes, are widely recognized for their significance as critical breeding habitat for waterfowl (Batt et al. 1989). Wetlands also support a diverse assemblage of water dependent birds including Montana species of concern such as the Black-crowned Night-Heron (*Nycticorax nycticorax*), White-faced Ibis (*Plegadis chihi*), Franklin's Gull (*Larus pipixcan*), Common Tern (*Sterna hirundo*), Forster's Tern (*S. forsteri*), American White Pelican (*Pelecanus erythrorhynchos*), and Black Tern (*Chlidonias niger*). Amphibian species of concern within the project area include the northern leopard frog (*Rana pipiens*), plains spadefoot (*Spea bombifrons*), and great plains toad (*Bufo cognatus*). The western hognose snake (*Heterodon nasicus*) is also a wetland-dependent species insofar as it feeds on toads, themselves dependent on standing water during part of their life cycle.

The small mammal community in prairie wetlands in Montana is primarily composed of five species: masked shrew (*Sorex cinereus*), muskrat (*Ondatra zibethicus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), deer mouse (*Peromyscus maniculatus*), and meadow vole (*Microtus pennsylvanicus*), all important food sources for prairie predators. The heavier vegetation cover natural to pothole wetlands serves as a population reservoir for small mammals. Bats are also dependent in some part on wetlands, as obligate insectivores, and on the roosting sites found in cottonwood forests.

Wetlands and riparian areas are also important habitat for larger mammals including red fox (*Vulpes vulpes*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), mink (*Mustela vison*), weasels (*Mustela* spp.), striped skunk (*Mephitis mephitis*), and deer (*Odocoileus* spp.). Whitetail deer (*O. virginianus*) are abundant in the riparian corridor along the rivers. In recent years, grizzly bears (*Ursus arctos*) have expanded their range across the study area, and have been found as far east as the confluence of the Marias and Missouri Rivers.

Methods

Site Selection

We used wetland polygons mapped by the NWI in the 1980's to generate a pool of potential sample sites (i.e., the sample frame) for random site selection. We stratified sites by Level IV ecoregion to maximize within-ecoregion similarities and minimize between-region variability in vegetation, geology, and climate (Van Sickle and Hughes 2000). The sample frame included all palustrine wetland types mapped by the NWI. The survey design followed a Generalized Random Tessellation Stratified (GRTS) procedure for discrete objects with reverse hierarchical randomization (Stevens 1997). All 161,003 NWI polygons within the sample frame were treated as the discrete objects with locations identified by the wetland polygon centroid. The GRTS design was selected because it creates a spatially balanced sample among randomly selected sites (Stevens and Olsen 1999, Stevens and Olsen 2004). This approach can account for the spatial patterning inherent in ecological systems (i.e., sites in close proximity tend to be more similar than widely separated sites). Spatially balanced sampling is also more efficient than simple random sampling because it can minimize the redundancy inherent in a simple random sample, which might select multiple proximate sites (Stevens and Jensen 2007). An unequal probability stratified survey design was then used to select sample sites stratified by Level IV ecoregion (Omernik 1987). The number of sites selected within each Level IV ecoregion was proportional to the area of each ecoregion within the project area.

Sixty-six percent (10,344,286 acres) of the Milk, Marias, and St. Mary project area is in private ownership. To ensure that wetlands on the remaining 34% (5,457,880 acres) publicly owned lands were included in our sample frame, two subpopulations were identified where approximately 50% of the selected wetlands occurred on privately owned lands and 50% occurred on public land. A total of 1,314 wetlands were selected from the NWI based sample frame with a 50% oversample to account for wetlands that no longer existed or were inaccessible due to denied access by private landowners.

For the Level 1 landscape analysis, all 1,314 wetland points were included. To select sites for the Level 2 rapid wetland field assessments, we used a two-stage approach. First, to determine if the wetland polygons mapped in the 1980's still existed, each sample site was visually examined in ArcMap 9.3 (ESRI 2008) using 1m resolution aerial imagery taken in 2005 by the National Agricultural Imagery Program (NAIP). We determined land ownership for each wetland polygon from the original Level 1 site selection by spatially joining the NWI polygon centroid and cadastral land ownership data (Montana Department of Administration 1999). To ensure access to sites on private land, we contacted property owners by telephone or occasionally in person. If permission was denied, the site was dropped and the next accessible site was evaluated until the sample size included 123 wetlands proportionately distributed across the four Level IV ecoregions. We conducted Level 3 vegetation assessments on 44 of the Level 2 assessment sites. Sites for the intensive assessments were selected in the field based on vegetation characteristics.

Data Collection

Wetland Landscape Profile

Certain wetland types may perform certain functions better than other wetland types (Brinson 1993, Johnson 2005). For example, wetlands located in floodplains tend to have a high sediment retention function while wetland flats have a low sediment retention function. The ability of wetlands to effectively perform certain functions depends upon vegetation, landscape position, water source, and hydrodynamics (Brinson 1993). Cumulative impacts to wetlands within watersheds will have significant additive effects (Johnson 2005). Therefore, it is important to identify the type and location of wetland resources within a given watershed.

Wetland profiles provide information on the distribution and characteristics of wetlands within a watershed. We prepared landscape profiles using all the 161,003 mapped palustrine wetland polygons and ancillary data sources to summarize these and other attributes for fourth, fifth, and sixth code

hydrologic units. We supplemented the Cowardin wetland classification, which describes the system, dominant vegetation type, and water regime, with a hydrogeomorphic attribute that describes a wetland in terms of its landscape position and hydrology. This attribution allows wetland type to be associated with a wetland function. We calculated five metrics to produce the wetland profiles: 1) Density of wetlands, calculated as the total number of palustrine wetlands divided by total land acres within a given hydrologic unit; 2) Number and acreage of wetland types by Cowardin class, water regime and hydrogeomorphic type and code; 3) Percentage of wetlands on private, state, federal, and tribal lands; 4) Percentage of wetlands protected through conservation easements or land management based on the Protected Areas Database (Data Basin 2010); and 5) Percentage of altered wetlands (defined as those wetlands mapped with a "impounded" or "excavated" modifier).

Level 1 Landscape Analysis

A Level 1 landscape analysis was used to characterize potential landscape level disturbances at three spatial scales (100 meters, 300 meters, and 1,000 meters) from the wetland perimeter using the buffering and identify functions in ArcGIS. Landscape level indicators of disturbance were derived from available digital datasets including land cover/land use, hydrology, and roads (Appendix C). Given the lack of detailed up-to-date spatial data on livestock grazing and resource extraction, the 1m resolution NAIP aerial imagery was examined for evidence of either disturbance. Four major attributes were considered as possible sources of anthropogenic stressors: roads, hydrological modifications, land cover/land use type, and resource use. We evaluated and scored each attribute based on multiple metrics (Table 1). We assigned a rating to each metric for roads, hydrological disturbances, and resource use based upon its distance from the wetland or buffered wetland perimeter. For land cover/land use, metric ratings were assigned based upon the percent cover of each land cover type within the wetland polygon or wetland buffer. Disturbance ratings increased with either decreasing distance from the disturbance or increasing percent cover of each land cover type.

To calculate an overall Level 1 site score, we multiplied individual metrics by a given weight and then summed into an overall attribute score (Appendix C). The four attribute scores were then weighted and summed again to achieve a final site score.

Table 1. The Montana Natural Heritage Program Rapid Assessment Method attributes and component metrics.

Attribute	Metric
Landscape Context	Landscape Connectivity
	Buffer Width
	Buffer Length
	Buffer Condition
Size	Wetland Size Relative to Historic Conditions
Biotic Structure and Composition	Relative Cover of Native Plant Species
	Relative Cover of Tolerant Native Plant Species
	Cover of Noxious Plant Species
	Organic Matter Accumulation
	Patch Interspersion
Hydrology	Water Source
	Hydroperiod
	Hydrologic Connectivity
Physicochemical	Soil Surface Integrity
	Water Quality

Level 2 Rapid Assessments

We completed 123 Level 2 rapid wetland assessments. Field ecologists used the Montana Ecological Integrity Assessment (EIA) form (Appendix D) developed by the MTNHP to assess wetland condition for all wetland types within the project area. The EIA approach uses a set of ecological attributes that reflect both the structure and function of the wetland to assess ambient condition (Table 1). Each ecological attribute contains one or more indicators to represent the status or trend of the attribute. These indicators are measured by metrics that include narrative ratings scaled along a gradient of wetland condition status. Each metric consists of three to five narrative statements that are assigned an ordinal scale value. Higher numbers correspond with increasing levels of disturbance. Each metric rating is summarized into an overall attribute score for five attributes: 1) Landscape Context; 2) Relative Patch Size; 3) Biotic; 4) Physicochemical; and 5) Hydrology. The ratings for these five attributes are then combined to produce an overall EIA condition score (Collins et al. 2004; Appendix E).

At each sample point, we established a 0.5 hectare assessment area (AA). The AA is the boundary of the wetland (or a portion of the wetland) targeted for sampling and analysis and is defined as all wetland area of the same ecological system type within a 0.5 hectare area around the sample point. If the wetland was smaller than 0.5 hectares and included a single ecological system, the entire wetland was assessed. In wetlands where several ecological systems occurred, the center of the AA was adjusted up to 50 meters so that the AA consisted of only one ecological system.

Once the AA was defined, we recorded general site characteristics (e.g., elevation, soil drainage, topographic position, amount of the AA covered by standing water, HGM class, and Cowardin system). We also collected soils data at each site by excavating two 45–60 cm deep soil cores in representative areas of the AA. For each soil layer, the depth, texture, matrix color, and abundance and color of redoximorphic features were recorded. Soil colors were determined using Munsell Soil Color Charts (USDA Natural Resources Conservation Service 2006; Munsell Color Company 2000).

The EIA form also contains a stressors checklist developed by the MTNHP. Stressors on the checklist include paved roads, developed buildings, mining activity, agriculture, and logging within 500 meters of the AA perimeter and within the AA. Stressors to wetland hydrology within 500 meters of the AA include impoundments, pumps, diversions, and dikes. Observed stressors were tallied to create a disturbance gradient. We assumed that a wetland with more stressors present will be more impaired than a wetland with no or few stressors (Miller and Wardrop 2006).

Level 3 Intensive Assessments

The MTNHP EIA method uses vegetation as an intensive biological measure to assess wetland condition (see Appendix F for field form) and to validate both the Level 1 landscape analysis and the Level 2 rapid assessments (Wardrop et al. 2007). Vegetation was selected because wetland plants are generally good indicators of the cumulative impacts of disturbances on wetland condition (Cronk and Fennessy 2001). In addition, vegetation can be assessed in all types of wetlands, including those that only have standing water seasonally, whereas indicators such as water chemistry, diatoms, and macroinvertebrates require standing water for most or all of the growing season.

Intensive Level 3 vegetation data were collected at 44 of the Level 2 sites using a 20 m x 50 m relevé plot (Peet et al. 1998). The structure of the plot consists of ten 10 m x 10 m (100 m^2) modules typically arranged in a 2 x 5 array (Appendix G). The plot was subjectively placed within the AA to maximize abiotic/biotic heterogeneity and to capture micro-site variations produced by hummocks, water tracks, side-channels, pools, wetland edge, and microtopography. The absolute cover of all vascular species within four of the 100 m2 modules was estimated using the cover classes developed by Peet et al. (1998; Appendix G). The area covered by standing water, bare ground, litter and bryophytes was also estimated for each module. Cover class midpoints were used to calculate average cover values over the entire relevé plot for each taxon.

For Level 3 assessment sites, multiple vegetation metrics were used to conduct a Floristic Quality Assessment (FQA). Previous studies have demonstrated that the FQA is a good predictor of wetland condition (Lopez and Fennessy 2002, DeKeyser et al. 2003, Jones 2004, Hargiss et al. 2008). A FQA accounts for the presence of exotic species, the richness of native species, and an individual plant species' tolerance and sensitivity to disturbance (Cronk and Fennessy 2001, Miller and Wardrop 2006). Similar indices of plant community integrity have been used in wetlands in the Prairie Pothole region of North Dakota and found to be robust in assessing the influence of anthropogenic and natural disturbances on plant communities (Hargiss et al. 2008). However, it is recommended that when developing indices for plant communities in this region, wetlands be separated by their hydrologic regime (Hargiss et al. 2008). For this reason Level 3 results for temporarily, seasonally, and semi-permanently flooded wetlands were analyzed separately.

Data Analysis

Descriptive statistics were generated for all Level 1, 2, and 3 data, and the range and distribution of each metric were examined using frequency histograms. We calculated Spearman's correlation coefficients to analyze relationships among and between metric and attribute scores for each level of assessment. Level 1 data from the landscape analysis were compared to Level 3 vegetation data to assess the relationships between disturbances in the surrounding landscape and wetland condition in the project area. All statistical analyses were conducted in R 2.10.1 (R Core Development Team 2009). Correlations were considered significant at $p \leq 0.05$. Correlations were ranked as: strong ($r > 0.5$); moderate (0.4 and 0.5); or weak (less than $r < 0.4$) (Hychka et al. 2007).

For the FQA, we assigned Coefficients of Conservatism (C-values) ranging from 0 to 10 to all plants identified to species (Northern Great Plains Floristic Quality Assessment Panel 2001). C-values were assigned as:

- 9-10: Native species that exhibit a high degree of ecological specificity.
- 7-8: Native species typical of well established communities that have minimal disturbance.
- 4-6: Native species found in certain wetland systems that can tolerate moderate disturbance.
- 1-3: Widespread native species that occur in a variety of communities and are common in disturbed sites.
- 0: Exotic species

Metrics in the FQA include native species richness, non-native species richness, total species richness, mean C-value of all plants, mean C-value of just native plants, and a cover weighted mean C-value for both native species and total species and a Floristic Quality Index (see Appendix H for complete list of formulas). Lower FQI and mean C-values indicate that the site is dominated by plants that are frequently found in disturbed areas while higher values indicate a greater floristic quality (Lopez and Fennessy 2002). Although the FQI is computed only for native species, it is also useful to calculate an FQI that includes non-native species, as their presence in a site is often a response to a disturbance (Lopez and Fennessy 2002, Miller and Wardrop 2006, Bourdaghs et al. 2006, Milburn et al. 2007).

The depressional and pothole wetlands found in the study area are inherently species poor. Typically, the FQI is sensitive to species richness, so species-poor sites will receive a lower FQI value despite being in or close to a natural state. Therefore, we calculated an adjusted FQI (Miller and Wardrop 2006) that incorporates a "maximum attainable FQI score" based on the highest possible value as well as both native and non-native species scores, into the final index.

A cover-weighted FQI was also calculated using the relative average cover of a species in the entire plot as a weighting factor (Milburn et al. 2007). This cover-weighted FQI was also calculated for native species alone, and for the adjusted FQI. A cover-weighted adjusted FQI was also produced for each site using the relative average cover of a species in the entire plot as a weighting factor

(Milburn et al. 2007). Refer to Appendix H for formulas.

We predicted the response of vegetation metrics to increasing human disturbance to test the assumptions supported in published wetland research (Table 2). Using Spearman rank correlation analysis we compared the observed relationship between Level 1 landscape level metrics and the Level 3 FQA metrics with expected relationships. Correlation results between Level 1 metrics and FQA indices in the expected direction (positive or negative) were interpreted as an indication of responsiveness to human disturbance (Stein et al. 2009).

Table 2. Predicted responses of vegetation metrics to increasing levels of human disturbance.

Vegetation Metric	Predicted Response to Increasing Human Disturbance
Non-Native Richness	Increase
Native Richness	Decrease
Total Richness	Decrease
% Natives	Decrease
% Non-natives	Increase
Mean C	Decrease
Mean C Nat	Decrease
Cover-Weighted Mean C	Decrease
Cover-Weighted Mean C of Natives	Decrease
FQI all species	Decrease
FQI	Decrease
Adjusted FQI	Decrease
Adjusted Cover-Weighted FQI	Decrease

Results

Wetland Landscape Profile Results

The project area includes 22 4th code hydrologic units equaling 15,794,321 acres. Of the total, 10,344,286 acres are private and 5,457,886 acres are public. The dominant ecological systems include an upland matrix of cultivated crops (32,723 acres), Northwestern Great Plains Mixedgrass Prairie (29,216 acres), and Introduced Upland Vegetation - Annual and Biennial Forbland (13,912 acres). Complete tables and maps for the wetland landscape profile for fifth and sixth code hydrologic units are included in Appendix I.

Wetland Density

Based on 1980s NWI mapping, wetland and riparian areas are more concentrated between Havre and Malta and in the watersheds located in the southwestern portion of the study area (Figure 4). Wetland density is similar, with watersheds around Malta and Havre having the greatest density of wetlands followed by the watersheds west of Cut Bank (Figure 5). The Wild Horse Lake watershed had the highest wetland density, followed by the Battle Creek and Cottonwood Creek watersheds.

Number and Acreage of Wetland Types

The majority of wetlands in the project area are freshwater emergent wetlands with a temporarily or seasonally flooded water regime (Table 3). Wetlands associated with riverine systems are the dominant hydrogeomorphic type; these are through-flow basins associated with lotic systems. Wetlands are considered to have a riverine HGM type if they are located within 100 meters of a perennial or intermittent stream and 20 meters of

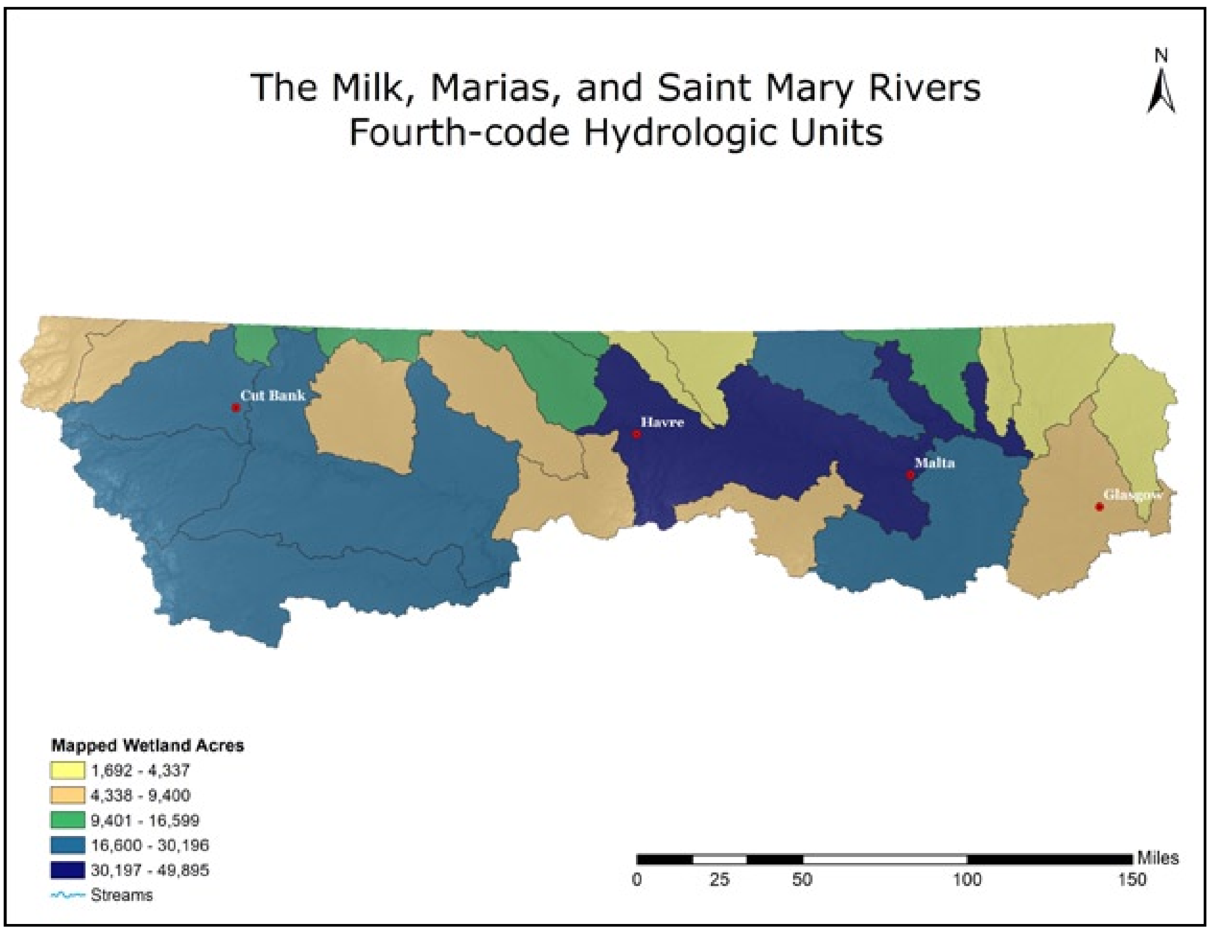

Figure 4. Acres of mapped wetlands within the project area.

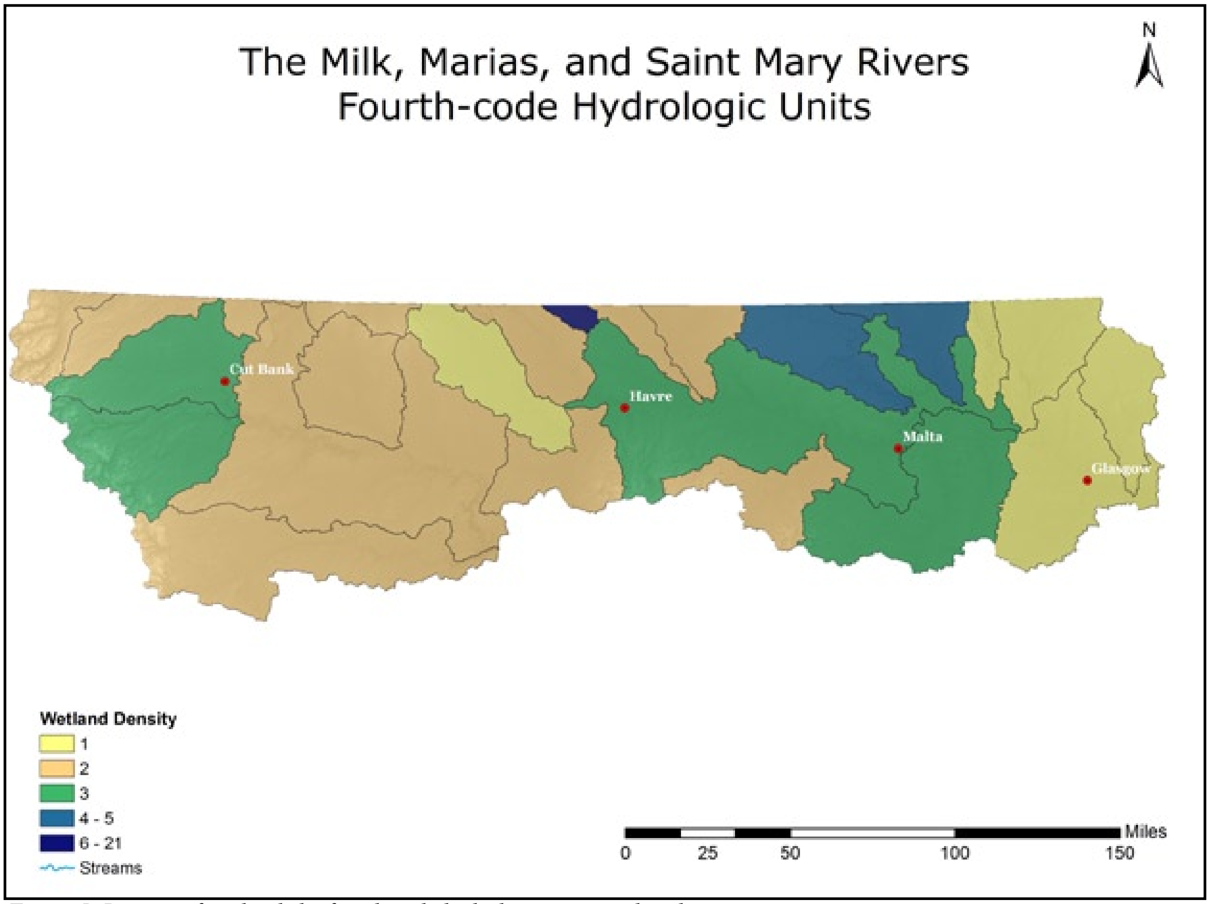

Figure 5. Density of wetlands by fourth code hydrologic units within the project area.

an ephemeral stream. The second most common hydrogeomorphic type for wetlands in the project area is depressional.

Percentage of Wetlands on Private, Public, and Tribal Land

Most wetlands in the project area are located on private land (Table 4). In some watersheds, including Wild Horse Lake, Sage Creek, and Willow Creek, wetlands occur almost exclusively on private land (Figure 6). Wetlands in other watersheds, including the Milk River Headwaters and Cut Bank Creek, are mostly on tribal lands. Only a small percentage of wetlands in each watershed are on state or federal land.

Percentage of Protected Wetlands

The percentage of wetlands protected through conservation easements or land management was calculated for each watershed based on the Protected Areas Database of the United States (Table 4). Based on the information in the database, wetlands within the Wild Horse Lake, Battle Creek, and Whitewater Creek watersheds are all considered protected. Other watersheds with a high percentage of protected wetlands include Cut Bank Creek, Milk River Headwaters, and Peoples Creek. However, it should be noted that the database characterizes public lands managed for natural resource use (e.g., grazing) as protected.

Percentage of Altered Wetlands

We calculated the percentage of altered wetlands using the impounded and excavated modifiers from the NWI Cowardin wetland classification attributes (Table 4). The wetland profile indicates that in the Battle Creek, Lower Milk River, and the Rock Creek watersheds, the percentage of altered wetlands exceeds the percentage of natural wetland types (Figure 7).

Table 3. Summary table of number, acres and percentage of total wetland acres by Cowardin classification water regime and class and associated hydrogeomorphic type and code.

Water Regime	# of Polygons	Acres	% of Total Wetland Acres
Temporarily Flooded	89,944	161,211	53%
Saturated	3,938	23,885	8%
Seasonally Flooded	41,295	78,905	26%
Semipermanently Flooded	19,675	36,357	12%
Intermittently Exposed	6,015	3,441	1%
Class	**# of Polygons**	**Acres**	**% of Total Wetland Acres**
Freshwater Emergent Wetland	129,091	246,634	81%
Freshwater Forested/Shrub Wetland	4,036	20,704	7%
Freshwater Pond	24,787	31,227	10%
Freshwater Pond Shore	3,097	5,590	2%
Hydrogeomorphic (HGM) Type	**# of Polygons**	**Acres**	**% of Total Wetland Acres**
Depressional	89,105	101,400	33%
Lacustrine	411	3,829	1%
Riverine	55,314	187,350	61%
Slope	16,817	12,195	4%

Hydrogeomorphic (HGM) Code	# of Polygons	Acres	% of Total Wetland Acres
Lentic Basin Through Flow (LE3BATH)	184	2,607	1%
Lotic River Floodplain Through Flow (LRFPTH)	1,155	4,323	1%
Lotic Stream Basin Through Flow (LSBATH)	51,318	155,446	51%
Lotic Stream Fringe Through Flow (LSFRTH)	2,499	26,149	9%
Terrene Basin Complex (TEBACO)	15,253	31,959	10%
Terrene basin Isolated (TEBAIS)	73,852	69,440	23%
Terrene Slope Complex (TESLCO)	2,201	3,191	1%
Terrene Slope Isolated (TESLIS)	14,616	9,003	3%

Table 4. Wetland landscape profiling of palustrine wetlands within each fourth code hydrological unit (HUC).

4th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Saint Mary River	10010002	0%	0%	25%	75%	81%	97%	3%
Two Medicine River	10030201	18%	0%	20%	61%	66%	98%	2%
Cut Bank Creek	10030202	7%	0%	1%	92%	79%	97%	3%
Marias River	10030203	91%	3%	6%	0%	35%	76%	24%
Willow Creek	10030204	90%	8%	2%	0%	13%	72%	28%
Teton River	10030205	67%	19%	14%	0%	53%	86%	14%
Milk River Headwaters	10050001	0%	0%	0%	100%	74%	97%	3%
Upper Milk River	10050002	68%	5%	28%	0%	49%	78%	22%
Wild Horse Lake	10050003	99%	0%	0%	0%	100%	99%	1%
Middle Milk River	10050004	76%	6%	11%	7%	57%	80%	20%
Big Sandy Creek	10050005	85%	4%	3%	8%	49%	83%	17%
Sage Creek	10050006	94%	6%	0%	0%	13%	73%	27%
Lodge Creek	10050007	85%	8%	7%	0%	24%	56%	44%
Battle Creek	10050008	72%	8%	20%	0%	100%	46%	54%
Peoples Creek	10050009	24%	6%	1%	68%	83%	77%	23%
Cottonwood Creek	10050010	77%	4%	19%	1%	66%	96%	4%
Whitewater Creek	10050011	57%	4%	38%	1%	100%	93%	7%
Lower Milk River	10050012	55%	5%	31%	9%	58%	47%	53%
Frenchman Creek	10050013	82%	8%	9%	0%	27%	78%	22%
Beaver Creek (Milk River)	10050014	68%	3%	27%	2%	77%	76%	24%
Rock Creek	10050015	51%	4%	45%	0%	73%	49%	51%
Porcupine Creek	10050016	37%	12%	4%	47%	37%	82%	18%

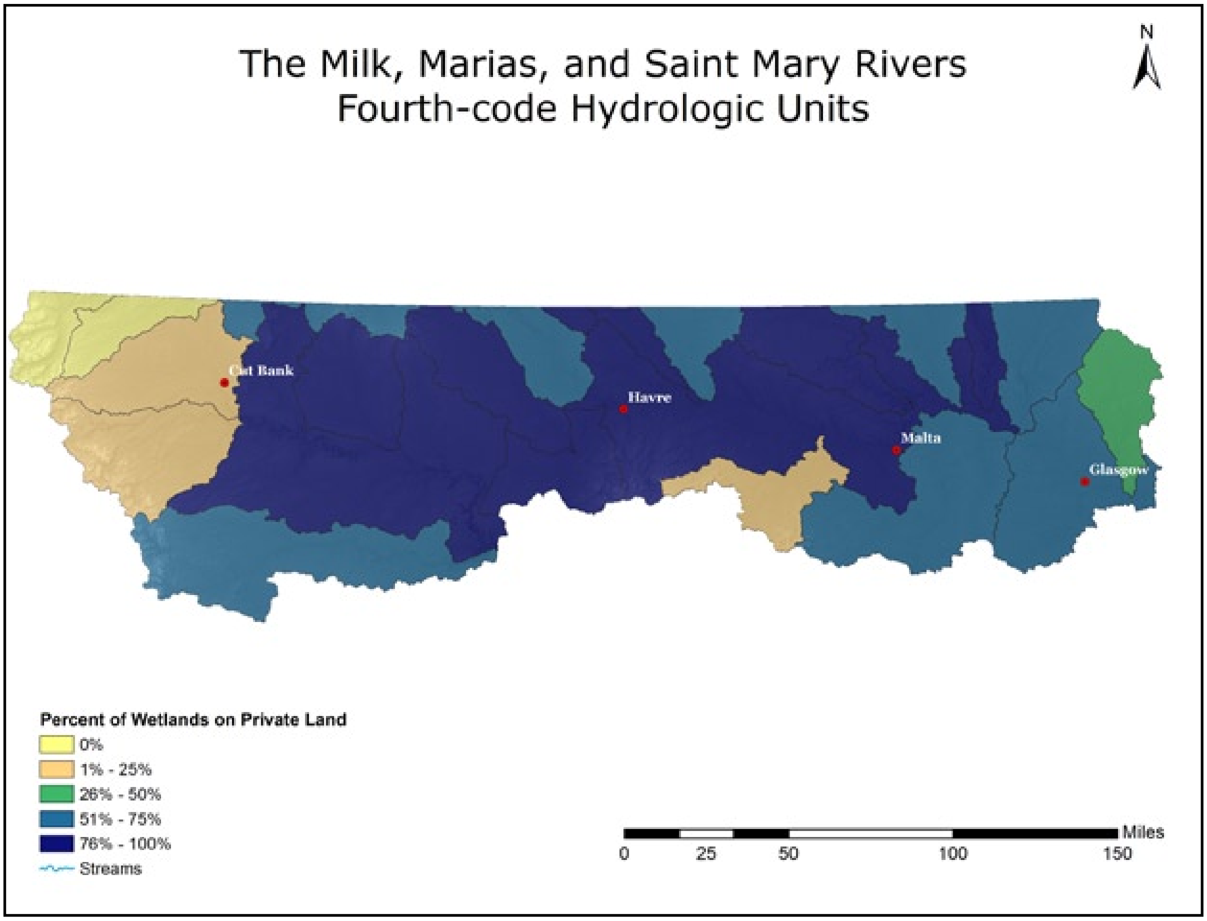

Figure 6. Percent of wetlands in the project area that are located on private land.

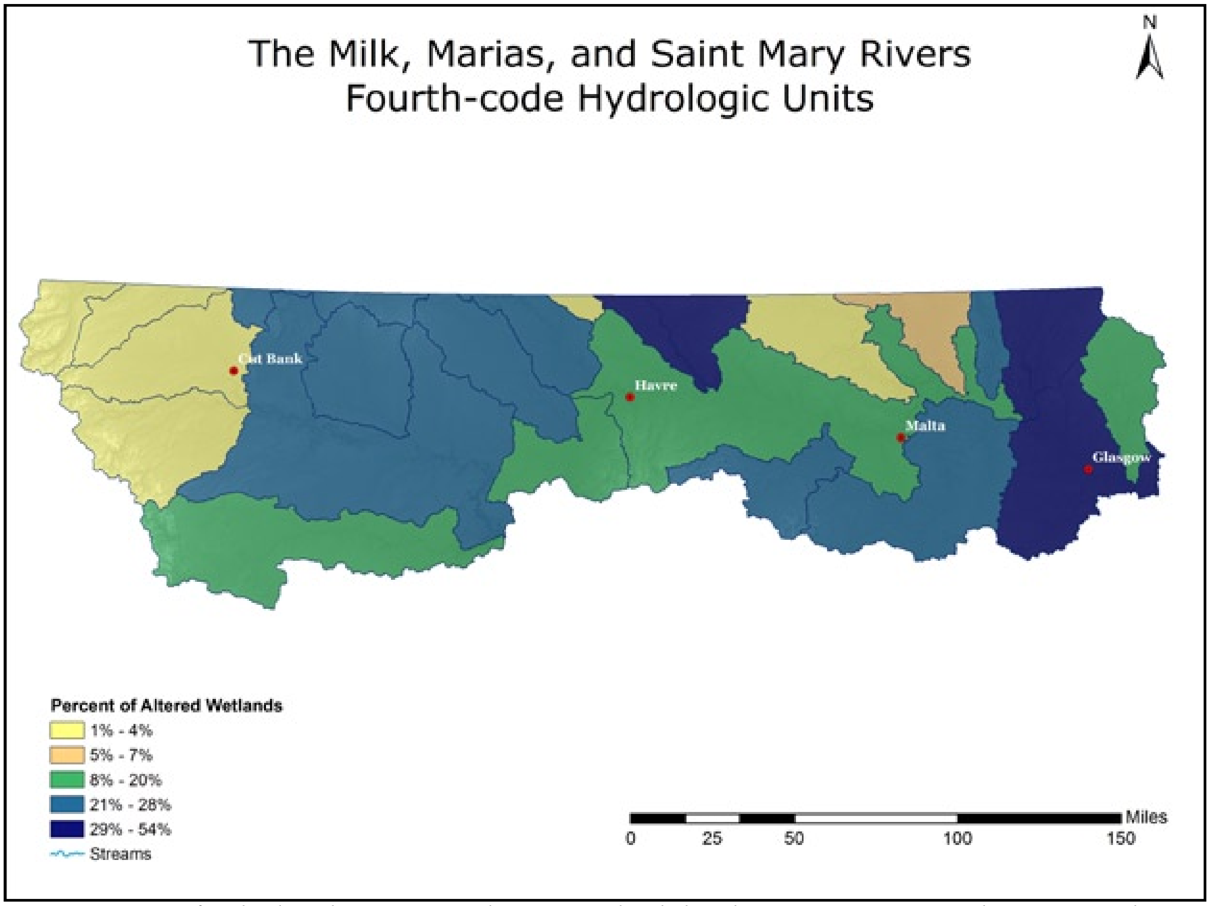

Figure 7. Percent of wetlands in the project area that are considered altered. Determination was made using Cowardin classification modifiers for impounded and excavated wetlands.

Level 1 Landscape Analysis Results

The Level 1 landscape analysis was conducted on 1,314 wetlands throughout the project area at three different spatial scales (100, 300, and 1,000 meters; Table 5). Sites with scores near one indicate little to no disturbance while increasing scores indicate increasing landscape disturbances. In general, landscape metrics showed little variability across all three spatial scales. Individual metric scores and overall attribute scores for most disturbance categories were clustered around one; however, transportation scores exhibited the greatest variability (Appendix J). The Local Roads metric had the highest mean scores within the Overall Roads attribute and among all of the metrics included in the Level 1 analysis, suggesting that they may influence the landscape context within the project area. The scores for this metric increased with increasing spatial scale. The Crop/Agriculture metric had the highest mean scores out of all the metrics within the Land Cover attribute and did increase with an increasing spatial scale. Wells scored the highest within the Hydrologic Disturbance Attribute, and Mines/Gravel Pits scored the highest within the Resource Use attribute. However, scores were similar at all three spatial scales for both metrics. The standard deviations around the mean for all metrics indicate that there is overlap between metric and attribute scores at all three spatial scales.

Level 2 Rapid Assessment Results

A total of 123 Level 2 wetland assessments were conducted during the summer of 2009 (Figure 8). The number of Level 2 sites by ecological system, Level IV Ecoregion, 4th code hydrological unit, and hydrogeomorphic type (HGM) are summarized in Table 6. Wetland assessment sites occurred in 6 of the 4th code HUCs, with most sites falling within the Milk River and Missouri-Marias wa-

Table 5. Mean Level 1 scores for landscape metrics, attributes and overall site score with standard deviations (S.D.).

	100 m Buffer		300 m Buffer		1000 m Buffer	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Four wheel drive	1.24	0.63	1.37	0.77	1.58	0.90
Local	2.10	1.33	2.52	1.41	3.33	1.21
Highway	1.14	0.68	1.19	0.80	1.33	1.08
Transportation Score	1.49	0.62	1.68	0.70	2.07	0.77
Medium Density	1.00	0.09	1.00	0.06	1.00	0.06
Low Density	1.02	0.18	1.01	0.07	1.01	0.07
Open Development	1.04	0.23	1.02	0.15	1.00	0.05
Crop/Agriculture	1.95	1.59	2.15	1.65	2.49	1.69
Hay/Pasture	1.92	1.56	1.07	0.40	1.70	1.26
Land Cover Score	1.43	0.70	1.36	0.50	1.55	0.50
Ditches	1.08	0.38	1.11	0.44	1.18	0.56
Wells	1.20	0.59	1.22	0.61	1.26	0.71
Reservoirs	1.01	0.10	1.02	0.17	1.08	0.39
Hydrology Score	1.11	0.26	1.12	0.27	1.18	0.34
Livestock	1.12	0.56	0.92	0.80	1.18	0.72
Mines/Gravel pits	1.90	0.99	1.99	1.00	1.99	1.00
Resource Use Score	1.39	0.49	1.29	0.52	1.47	0.58
Overall Level 1 Score	1.38	0.31	1.40	0.32	1.62	0.37

tersheds. The dominant ecological system represented by assessed wetlands was the Western Great Plains Open Freshwater Depression (n=49) within the Glaciated Northern Grasslands and North Central Brown Glaciated Plains Level IV Ecoregions (Omernik, 1987). The Great Plains Prairie Pothole (n=19), Northwestern Great Plains Riparian (n=15), Western Great Plains Closed Freshwater Depression (n=13), and Great Plains Saline Depression (n=8) were also well-represented. A number of additional ecological systems were also assessed but were not as common: Emergent Marsh (n=5), Alpine-Montane Wet Meadow (n=6), Rocky Mountain Subalpine-Montane Fen (n=1), Northern Rocky Mountain Wooded Vernal Pool (n=1), and Intermountain Basins Greasewood Flat (n=1). A few riparian systems were represented among assessed wetlands, including Lower Montane Riparian Woodland and Shrubland (n=1), Rocky Mountain Subalpine-Montane Riparian Shrubland (n=2), Rocky Mountain Subalpine-Montane Riparian Woodland (n=1), and the Western Great Plains Floodplain system (n=1).

Level 2 EIA Condition Scores

EIA scores for attributes were well distributed for the Landscape Context, Biotic, Hydrologic, and Physicochemical Condition attributes (Appendix K). More sites scored higher for the Landscape Context and Hydrologic Disturbance metrics. The Biotic scores were concentrated in the middle of the range and the Relative Patch Size scores were predominantly high with a small proportion scoring extremely low. Overall condition scores ranged from 50 to 100, with a higher frequency of sites ranking between 80 and 100 (Figure 9).

Overall EIA scores were averaged for each ecological system (Table 7). The following describes the scores for each ecological system (refer to tables in Appendix L and frequency histograms in Appendix M). Only wetlands with assessment data from eight or more sites are discussed. Based on the condition thresholds established in the MTNHP EPA Reference Wetland Project (Newlon 2011) wetlands were grouped into four categories: relatively unaltered (scores = 90-100), slightly altered (scores = 80-89),

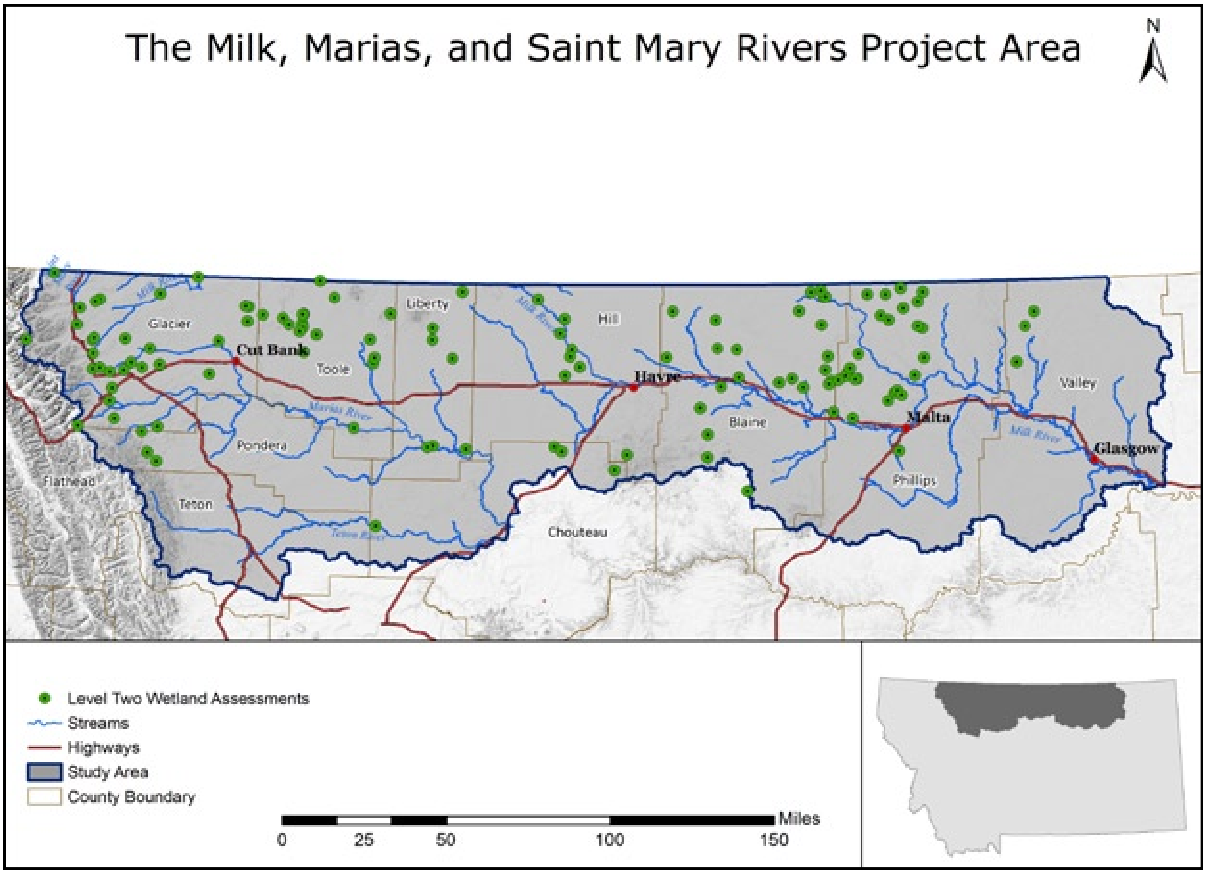

Figure 8. Distribution of Level 2 assessments.

moderately altered (scores = 70 – 79), and severely altered (scores < 70).

Western Great Plains Depressional Wetland Systems

Great Plains Prairie Potholes scored the highest, followed by Western Great Plains Saline Depressions. Western Great Plains Open and Closed Depressions received lower minimum scores than any other system. Of the Great Plains Prairie Potholes assessed, most of the sites were either relatively unaltered or slightly altered. Three sites were considered moderately altered while three sites were severely altered (Figure 10). Overall condition scores for Western Great Plains Closed Depressions were evenly distributed, with five sites ranked as slightly altered, four sites ranked as moderately altered, and four sites considered severely altered. Thirty-four of the 49 Open Depression wetlands were ranked as moderately to severely altered. Only five Open Depressions were considered to be relatively unaltered. Seven of the eight Saline Depression sites assessed were ranked as slightly altered to relatively unaltered with only one site considered moderately altered.

Northwestern Great Plains Riparian

Out of the 15 sites assessed only two wetlands were ranked relatively unaltered and slightly altered. Four sites were ranked moderately altered while the remaining sites are considered severely altered (Figure 10).

Wetland Condition and Water Duration

Correlation coefficients were compared between each Level 2 attribute score and Cowardin wetland classification water regimes to see if there were any relationships between wetland condition and the duration of standing water (Table 8). The only metric that had a significant correlation to increased water duration was the Biotic attribute, indicating

Table 6. Number of Level 2 sites by Level IV Ecoregion, 4th code hydrological unit, and hydrogeomorphic type (HGM).

Level IV Ecoregion		N
17r	Scattered Eastern Igneous-Core Mountains	2
41a	Northern Front	3
41b	Crestal Alpine-Subalpine Zone	1
41c	Western Canadian Rockies	1
41d	Southern Carbonate Front	1
42j	Glaciated Northern Grasslands	40
42l	Sweetgrass Uplands	1
42m	Cherry Patch Moraines	12
42n	Milk River Pothole Upland	6
42o	North Central Brown Glaciated Plains	32
42q	Rocky Mountain Front Foothill Potholes	13
42r	Foothill Grassland	10
43l	Missouri Breaks Woodland Scrubland	1
HUC 4		**N**
Big Sandy Creek		1
Milk River		78
Missouri-Marias		39
Missouri-Musselshell		1
Saskatchewan		1
St. Mary		3
HGM Type		**N**
Depressional		95
Riverine		19
Slope		6
Flat		1
Lacustrine Fringe		2

that wetlands that hold standing water for longer may have fewer non-natives and tolerant native species.

Wetland Condition and Human Disturbance Gradient

To assess the relationships between the Level 2 attribute scores and the stressors recorded on the stressor checklist in the field, we analyzed correlations between Level 2 attribute scores and the count of different stressor types (Table 9). There were only weak correlations between the two; however, the inverse relationships indicate that the increasing number of stressors may lead to a decline in condition. Buffer and transportation stressors were negatively correlated with the Landscape Context attribute and buffer stressors and hydrology stressors were negatively correlated with the Physicochemical attribute.

Level 3 Analysis Results

Level 3 vegetation data were collected from 44 sites and then used to assess wetland condition for each site in the study area based on the FQA. Since the majority of the wetlands included in this project were depressional wetlands that undergo cyclic fluctuations in water levels, FQA metrics were calculated and compared separately for wetlands clas-

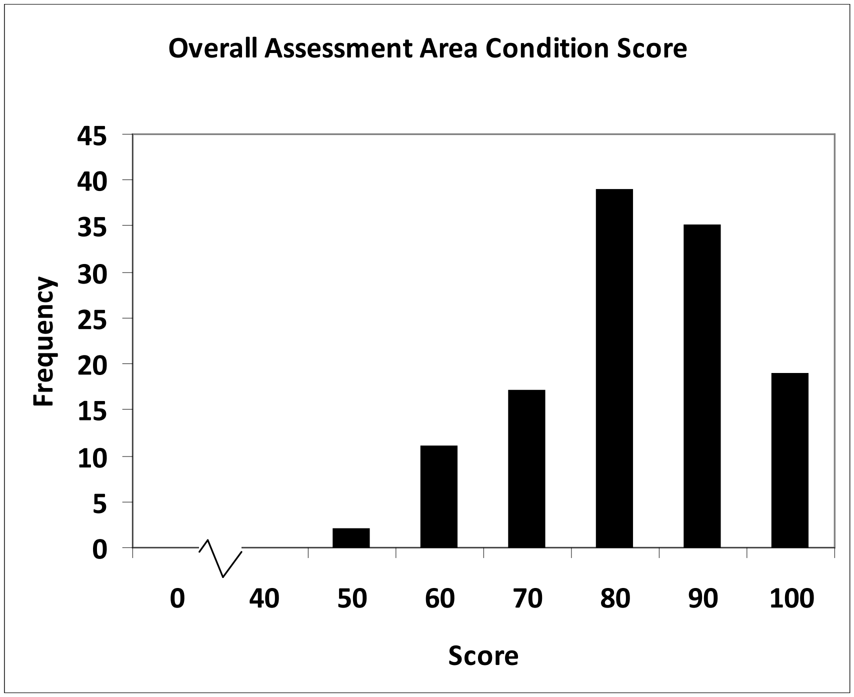

Figure 9. Overall condition scores for Level 2 wetland sites.

Table 7. Mean overall EIA scores with their standard deviations and minimum and maximum scores for each ecological system.

Ecological System	N	Mean	S.D.	Min	Max
Great Plains Prairie Pothole	19	83.6	11.1	57.5	98.3
Western Great Plains Closed Depression Wetland	13	73.4	13.7	42.7	87.7
Western Great Plains Open Freshwater Depression Wetland	49	73.4	11.7	47.7	98.3
Western Great Plains Saline Depression Wetland	8	87.3	7.9	73.7	96.7
Northwestern Great Plains Riparian	15	72.2	12.1	53.2	92.2
Western Great Plains Floodplain Systems	1	73.5	~	~	~
Inter-Mountain Basins Greasewood Flat	1	87.5	~	~	~
North American Arid West Emergent Marsh	5	82.1	6.5	74.9	89.8
Rocky Mountain Alpine-Montane Wet Meadow	6	85.5	10.2	71.6	98.3
Northern Rocky Mountain Wooded Vernal Pool	1	53.3	~	~	~
Rocky Mountain Subalpine-Montane Fen	1	69.3	~	~	~
Rocky Mountain Lower Montane Riparian Woodland and Shrubland	1	86.5	~	~	~
Rocky Mountain Subalpine-Montane Riparian Woodland	1	79.2	~	~	~
Rocky Mountain Subalpine-Montane Riparian Shrubland	2	94.0	3.3	91.7	96.4

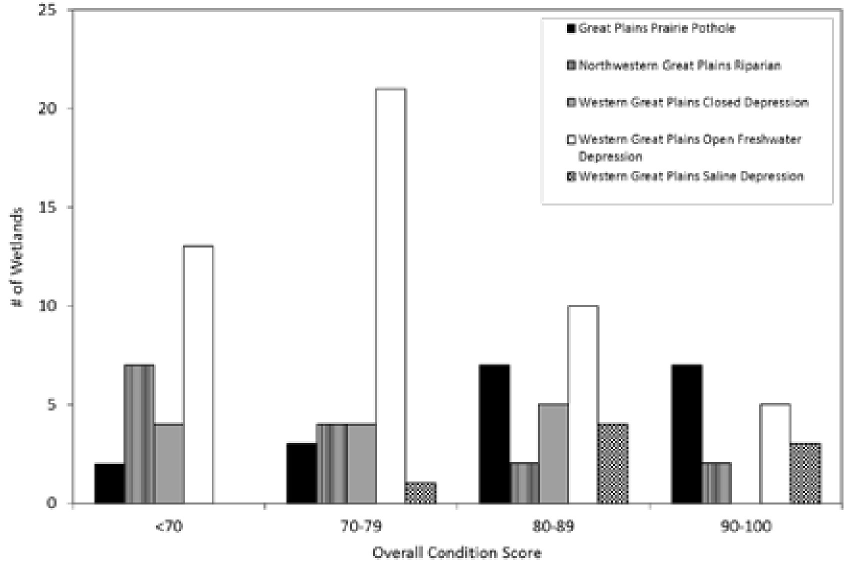

Figure 10. Overall condition scores for the dominant ecological systems within the project area.

Table 8. Correlations between Level 2 attribute scores and Cowardin water regimes using Spearman's correlations. All relationships that are significant at the= 0.05 level are indicated in boldface.

	Water Duration
Final Land Context	0.07
Final Relative Patch Size	0.12
Final Biotic	**0.32**
Final Hydrologic	-0.06
Final Physicochemical	0.10
Final AA Score	0.16

Table 9. Correlations between Level 2 attribute scores and the number of different stressor types using Spearman's correlations. All relationships that are significant at the= 0.05 level are indicated in boldface.

	Buffer Stressors	Land Use Stressors	Transportation Stressors	Hydrologic Stressors	Stressors in the AA	Total Stressors
Final Land Context	**-0.26**	**-0.2**	**-0.27**	-0.13	0.06	**-0.22**
Final Relative Patch Size	0.01	0.15	-0.01	-0.04	-0.06	-0.01
Final Biotic	-0.16	-0.02	-0.04	**-0.21**	-0.01	-0.14
Final Hydrologic	**-0.19**	-0.05	-0.06	**-0.23**	0.07	-0.17
Final Physicochemical	**-0.21**	-0.16	0.07	**-0.25**	**-0.27**	**-0.25**
Final AA Score	**-0.25**	-0.1	-0.11	**-0.25**	-0.08	**-0.25**

sified as temporary, seasonal, or semi-permanent (Table 10). However, there was very little variability found between the FQA metrics of wetlands with different water regimes. Species richness and the FQI for total species increased only slightly with increasing water duration. Vegetation metrics for native species had higher values while metrics including exotic species had lower values.

Our Level 3 results indicate that most of the wetlands assessed are dominated by species that can tolerate moderate disturbance as demonstrated by the cover-weighted mean c-values of species found most frequently (Figure 11). In addition, lower adjusted FQI values indicate that most of the assessed sites are dominated by plants that are frequently found in disturbed sites. Only a couple of the sites had a good floristic quality (Figure 12).

Wetland Condition and Human Disturbance Gradient

Relationships between FQA metrics and the Level 2 stressors checklist recorded on site were analyzed. It was expected that there would be stronger relationships than with the Level 1 landscape metrics. However, there were no significant correlations between the FQA metrics and the number of stressors. This can be attributed to the assumption that a wetland with more stressors present will be in more impaired condition than a wetland with no or few stressors. In contrast we found that several of the stressors observed independently had large scopes and more severe impacts than the accumulated impacts of many stressors.

The dominant human disturbances observed affecting wetland condition in the project area include roads, conversion of temporary and seasonal wetlands to dryland farming and stockponds, and soil and vegetation disturbance associated with heavy livestock grazing (Figure 13).

Effects of human induced disturbance may covary with natural disturbances. For instance, drought may be affecting wetland condition more than either local or landscape level human disturbances. Effects of drought include reduced zonation and encroachment by terrestrial vegetation in depressional wetland systems. In addition, many wetlands visited were no longer functioning as wetlands but contained relic hydric soils. The regional wetland

Table 10. Mean values for FQA indices by Cowardin water regime with their standard deviations (S.D.).

	Temporary (n=11)		**Seasonal (n=17)**		**Semi-permanent (n=16)**	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Non-native species richness	2	1	3	2	4	2
Native species richness	6	4	9	5	10	6
Total species richness	8	5	13	7	14	7
% Native species	74	14	76	13	70	14
% Non-native species	26	14	24	13	30	14
Mean C of total species	4	1	4	1	4	1
Mean C of native species	5	1	5	1	5	0
Cover-weighted mean C for total species	4	1	5	2	4	1
Cover-weighted mean C for native species	5	1	5	1	5	1
FQI for native species	10	3.2	13.5	4.6	13.6	5.6
FQI for total species	11.8	3.7	13.9	3.9	15.0	4.1
Cover-weighted FQI for total species	11.7	5.2	16.0	7.7	13.1	5.4
Cover-weighted FQI native species	12.4	4.3	14.9	5.4	14.4	3.9
Adjusted FQI	44.4	6.1	43.3	14.2	41.2	5.4
Adjusted cover-weighted FQI	46.6	7.1	46.2	15.9	40.1	8.5

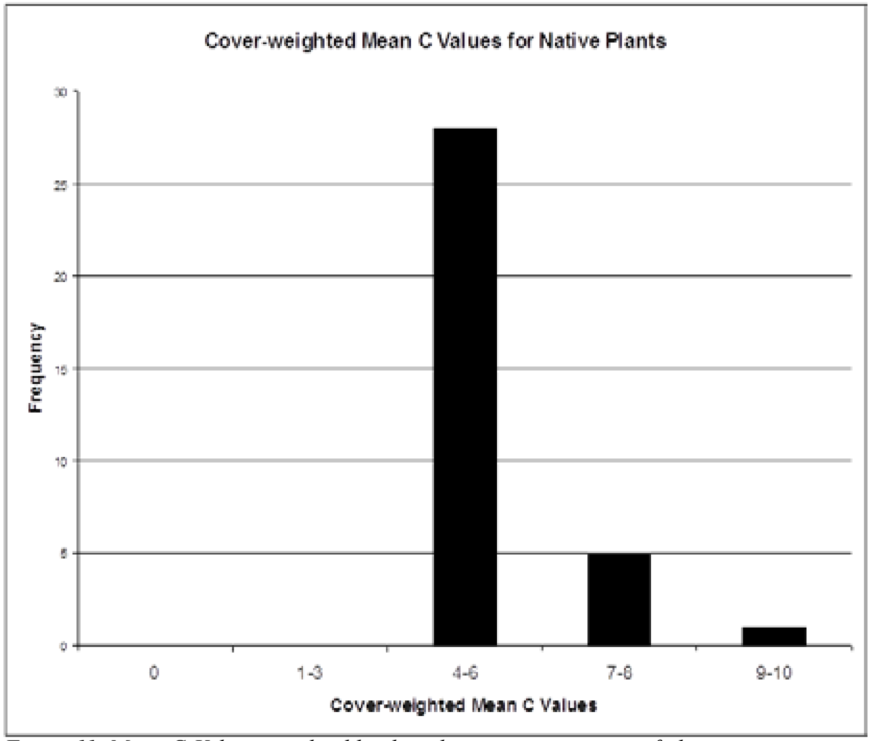

Figure 11. Mean C-Values weighted by the relative average cover of plant species in Level 3 vegetation plots.

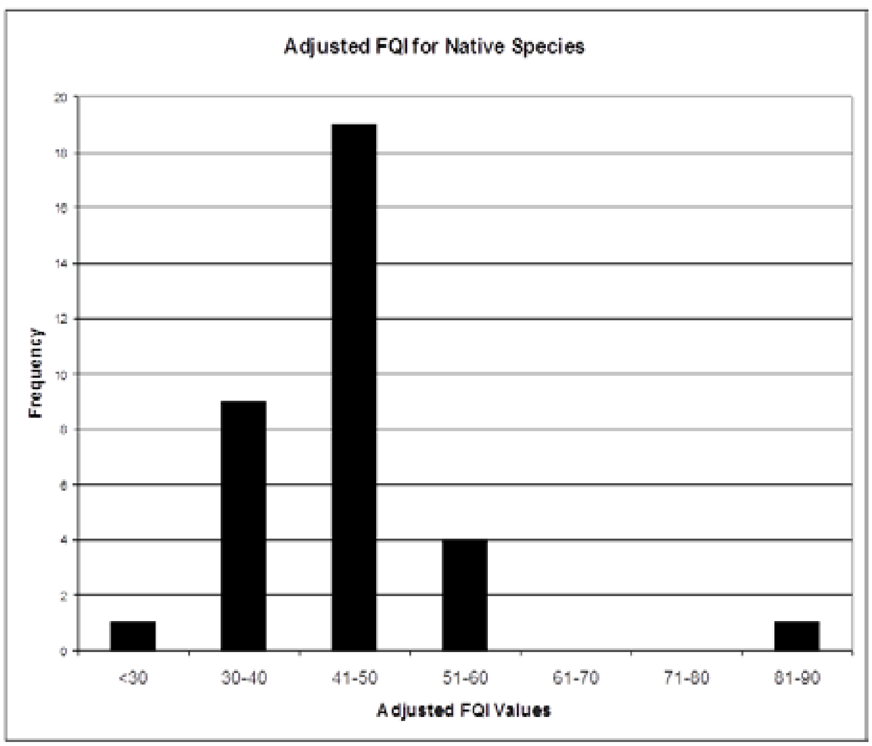

Figure 12. Frequency of adjusted FQI scores. The adjusted FQI incorporates a maximum attainable FQI score based on the highest possible value as well as both native and non-native species (Miller and Wardrop, 2006). This is a particularly important metric for ecological systems that are naturally species poor like depressional and prairie pothole systems.

Figure 13. Effects of heavy livestock grazing on wetland soil (left photo) and vegetation (right photo).

indicator status of plant species recorded for the Level 3 assessment indicate that the frequency of facultative upland (FACU) and upland (UPL) species is greater than would be expected in a fully functioning wetland (Figure 14).

To determine the relationship between drought and wetland condition, the relationship between the relative effective annual precipitation (REAP) and FQA metrics was analyzed (Table 11). Many of the FQA metrics were significantly and positively correlated to REAP. The FQI was strongly positively correlated with REAP, indicating that the floristic quality of wetlands increased in areas with increased precipitation. There were moderate correlations between REAP and total species richness, mean C-values, and the FQI for natives. Both cover-weighted FQI metrics were weakly correlated.

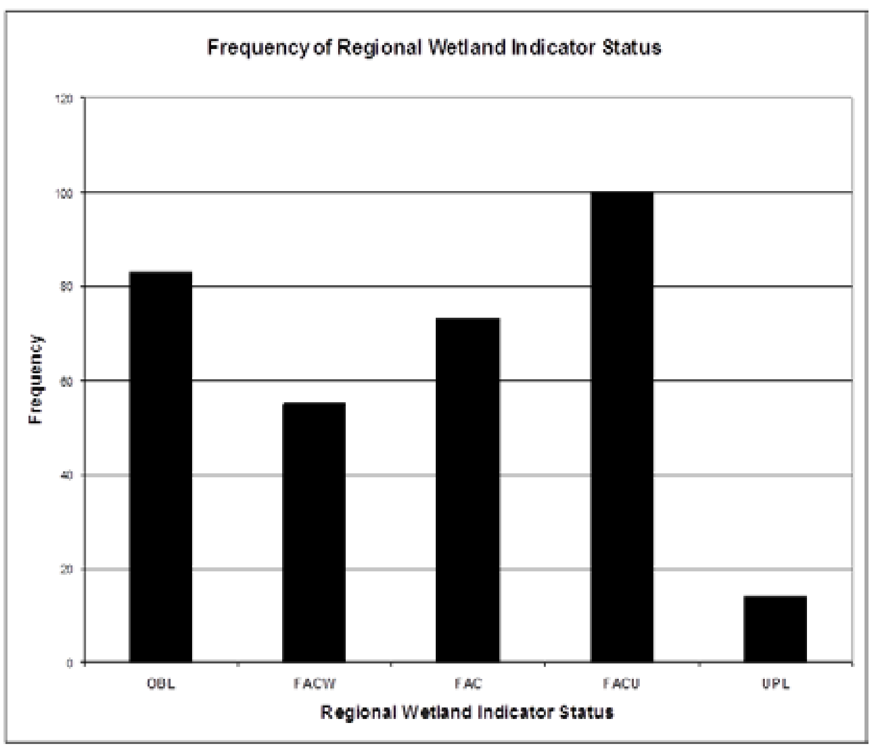

Figure 14. Frequency of species by their regional wetland indicator status (USFWS).

Table 11. Spearman correlations between Level 3 vegetation data and relative effective annual precipitation (REAP). All relationships that are significant at the= 0.05 level are indicated in boldface.

	REAP
NN Richness	0.19
N Richness	0.52
Total Richness	0.48
% Native	0.30
% Non-native	-0.30
Mean C	0.44
Mean C Nat	-0.22
CW Mean C	0.01
CW Mean C Nat	-0.10
FQI	0.60
FQI Nat	0.45
CW FQI	0.34
CW FQI Nat	0.37
Adj FQI	0.00
Adj CW FQI	0.01

Discussion

The goal of this project was to assess wetland condition in the Milk, Marias, and St. Mary watersheds using the EPA's three-tier approach to wetland assessments. An additional goal was to identify potential anthropogenic stressors affecting wetland condition both within the wetland area and in the surrounding landscape at varying spatial scales. Using wetland profiles it was determined that 81% of the wetlands within the project area are palustrine emergent wetlands with either temporary or seasonal water regimes. There are approximately 101,400 acres of depressional wetlands within the project area. Three watersheds were identified that had a greater number of altered wetlands than unaltered wetlands. This indicates that many of these wetlands are threatened and in need of local level protection.

The Level 1 landscape metric, attribute, and overall scores showed little variability at all three spatial scales. This is due, in part, to the homogeneity of the landscape within the project area. The dominant land uses in this part of Montana are dry land farming and livestock grazing, and much of the area is intersected by local dirt roads. Agricultural land cover within 100 meters of temporary wetlands was determined to influence wetland condition, whereas condition in semi-permanent wetlands is primarily influenced by roads within 100 meters. Because temporary wetlands are usually smaller, more shallow systems that dry out during the growing season, they often encounter more anthropogenic disturbances like tillage for crops within and directly adjacent to the wetland boundary (DeKeyser et al. 2003). With so little variability in the landscape, the landscape level analysis did not provide a reliable assessment of wetland condition.

Results for the Level 2 rapid assessments indicate that among depressional wetlands, Great Plains Prairie Potholes and Great Plains Saline Depressions are in better condition than either Great Plains Open or Closed Depressions. Great Plains Prairie Potholes and Western Great Plains Saline Depressions higher condition scores can be attributed to fewer impacts from livestock grazing. Prairie potholes occur in wetland complexes so that the effects of livestock are more evenly distributed on the landscape and Saline depressions are often dominated by vegetation that is unpalatable. Results for open and closed depression wetlands indicate that these systems are highly susceptible to human disturbances. Northwestern Great Plains Riparian systems had more sites ranked as severely altered, suggesting that these systems need more focused protection. The dominant human disturbances observed and affecting wetland condition include roads, conversion of temporary and seasonal wetlands to dryland farming and stock ponds, and soil and vegetation disturbance associated with heavy livestock grazing.

Level 2 scores were not highly correlated with stressors measured at the site using the stressor checklist. This indicates that either our metrics are not sensitive enough to capture changes in wetland condition from particular stressors or that the stressor checklist is inadequate. Because there were also no significant correlations between the stressors and the Level 3 FQA scores, it is most plausible that the stressor checklist is not a quantitative enough measure of disturbance. Using the tallied number of stressors observed at each site as an indicator of disturbance, it was assumed that the more stressors present at a site the greater the disturbance. What the stressor checklist does not take into account is that many stressors may be present but might only slightly affect wetland condition (e.g. light grazing, light recreation, and horse trail within 500 meters) while one stressor may be present that significantly affects wetland condition (culverts, impoundments, ditches). In the future the scope and severity of each disturbance should also be recorded.

There are several confounding issues with assessing wetlands in this region. Depressional wetlands are dynamic systems where wet-drought cycles influence the ecological communities present (Hansen et al., 1995). Therefore, our assessments are just a snapshot of the ecological condition of the wetland at that stage within its wet-drought cycle. Because assessment results may change depending on the wet-drought cycle it is important to assess

reference wetlands over a long period of time to establish a gradient of known conditions for wetlands with different water regimes (DeKeyser et al. 2003). There is a significant east to west moisture gradient across the Prairie Pothole region, with decreased precipitation on the western edge due to a rain shadow from the Rocky Mountains. The project area is within the most westerly edge of the Prairie Pothole region and therefore contains wetlands that are much drier and more temporary than wetlands in the eastern part. This east to west gradient increased over the twentieth century, where the western edge of the prairie pothole became significantly drier (Johnson et al. 2010).

Wetlands visited within the project area appeared to be drier than in the past, and in some cases were no longer functioning as wetlands. Many of the depressional wetlands included in the project clearly had historically been functioning temporary or even seasonal wetlands based on relic hydric soils or the presence of a few hydrophytes, but they no longer had the hydrology to sustain plant communities dominated by hydrophytes. These wetlands were dominated by upland species encroaching from the adjacent prairie. In addition, many of the depressional wetlands, while functioning, had reduced zonation, so that only one plant community was present. Wetlands that remain in the drought stage of their wet-drought cycle for long periods of time often end up in an unproductive condition (Johnson et al. 2010). Because plant communities in this region developed in the presence of disturbances like fire and grazing by Bison, in a landscape that lacks these intense, short-duration disturbances, they often become static, which can have a negative affect on wetland condition (DeKeyser et al. 2003). Impacts from drought are not measured in our Level 1 landscape analysis or our Level 2 rapid assessment. Other wetland assessment studies in the Prairie Pothole region have included the low prairie zone surrounding depressional wetlands in vegetation assessments to capture annual shifts of species between the upland and the wetland to account for a fluctuating water regime (DeKeyser et al. 2003). By including the low prairie zone in the future, we can better tease out the influences of adjacent anthropogenic disturbances and shifts in hydrology. In general, however, none of the three levels of assessment may be able to make clear connections between anthropogenic stressors and wetland integrity in this area. Stressors are too evenly distributed, and drought may be an overriding factor driving wetland condition.

The results from this study support the use of a spatially balanced and random survey design.
The condition scores for wetlands in this project were similar to the wetland scores of wetlands surveyed for the MTNHP reference network of wetlands in central and eastern Montana. However, there were more significant correlations between both the Level 1 and Level 2 assessments with the FQA metrics for the reference wetlands. This could be due to the fact that wetlands included in the reference network were targeted and therefore spatially autocorrelated (Moran's I = 0.66, z-score = 6.03) while sites in this project were not spatially autocorrelated (Moran's I = 0.03, z-score = 0.05).

Both the Level 1 and Level 2 need further calibration and refinement based on intensive Level 3 assessments. Additional Level 3 assessments should be developed to help in the further validation of our methods. Based on this pilot project, the MTNHP will continue to develop indicators and metrics for a long-term integrated, statewide, multijurisdictional wetland condition monitoring and assessment strategy based on EPA's recommended elements.

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Appendix A. Ecological System Descriptions

Western Great Plains Closed Depressional Wetland

General Description

This system includes a variety of depressional wetlands generally found in complexes in central and eastern Montana. This type of wetland differs from Western Great Plains Open Depressional Wetlands and Great Plains Prairie Potholes by being completely isolated from both the regional groundwater system and inter-wetland surface drainage systems. They occur in depressional basins found in flat, enclosed upland areas or on level shallow lake basins. The major sources of input water are precipitation and snow melt, and water loss occurs through evapotranspiration. The basins are typified by the presence of an impermeable layer, such as dense clay formed in alluvium that is poorly drained. Subsurface soil layers are restrictive to water movement and root penetration. Ponds and lakes associated with this system can experience periodic drawdowns during dry years, but are replenished by spring rains. Closed depressions experience irregular hydroperiods, most filling with water only occasionally and drying quickly, influencing the plant communities that are present. The drawdown zone is typically dominated by western wheatgrass (*Pascopyrum smithii*) and foxtail barley (*Hordeum jubatum*). Povertyweed (*Iva axillaris*) and willow dock (*Rumex salicifolius*) occupy the broad, low gradient basins which are shallowly inundated in the spring and draw down every year to reveal bottoms of gray bentonite. Common spikerush (*Eleocharis palustris*) occurs within the drawdown area where there is more organic matter in the substrate. Hardstem bulrush (*Schoenoplectus acutus*) typifies closed depressions sufficiently deep to remain permanently inundated during most years. Species richness can vary considerably among individual examples of this system and it is especially influenced by adjacent land use like agriculture and grazing.

Diagnostic Characteristics
lowland, herbaceous, depression, depressional, playa, clay subsoil, impermeable layer, saturated, isolated wetland, strictly isolated wetland

Range
This system can be found throughout the eastern portion of the Western Great Plains; however, it is most prevalent in the central states of Nebraska, Kansas and Oklahoma. In Montana, closed depressions are most concentrated to the north of the HiLine and Route 2, from the Blackfeet Reservation to the North Dakota border. Individual depressions can also be found across the Northwest Glaciated Plains north of the Missouri River.

Environment
This system is typified by depressional basins found in flat enclosed upland areas and level shallow lake basins, with an impermeable layer such as dense clay isolating the wetland from the regional groundwater system. It differs from Western Great Plains Open Depression Wetlands and Great Plains Prairie Potholes by being completely isolated from both the regional groundwater system and inter-wetland surface drainage systems. These wetlands occur in depressional basins found in flat enclosed upland areas or on level shallow lake basins. The major sources of input water are precipitation and snow melt; water loss occurs through evapotranspiration. The basins are typified by the presence of an impermeable layer, such as dense clay formed in alluvium that is poorly drained. Subsurface soil layers are restrictive to water movement and root penetration (Cook and Hauer, 2007). Ponds and lakes associated with this system can experience periodic drawdowns during dry years, but are replenished by spring rains. Closed depressions experience irregular hydroperiods, filling with water only occasionally and drying quickly, which influences the plant communities that are present.

Vegetation
Vegetation within this system is highly influenced by hydrology, salinity, fire and adjacent land uses. The drawdown zone is typically dominated by western wheatgrass (*Pascopyrum smithii*) and foxtail barley (*Hordeum jubatum*), the most common wet meadow component of this landscape. Needle spikerush (*Eleocharis acicularis*) and the small annual forbs slender plantain (*Plantago elongata*) and purslane speedwell (*Veronica peregrina*) are common in most stands. Povertyweed (*Iva axillaris*) and willow dock (*Rumex salicifolius*) occupy the broad, low gradient basins which are shallowly inundated in the spring and draw down every year to reveal bottoms of gray bentonite. The common spikerush (*Eleocharis palustris*) association is also within the drawdown zone but occurs at sites where there is more organic matter in the substrate. Foxtail barley (*Hordeum jubatum*) and needle spikerush (*Eleocharis acicularis*) are typically well represented in drier stands, while water knotweed (*Polygonum amphibium*) stands are found at wetter sites. Marsh vegetation, dominated by hardstem bulrush (*Schoenoplectus acutus*), typifies depressions sufficiently deep to remain permanently inundated during most years. Forbs commonly associated with these marsh communities include water knotweed *(Polygonum amphibium*), common spikerush (*Eleocharis palustris*) and two headed water-starwort (*Callitriche heterophylla*).

Dynamic Processes
These systems developed under Northern Great Plains climatic conditions, which included natural disturbances by large herbivores, periodic flooding events and occasional fire. Wet-drought year climatic cycles in Montana, often in 10 to 20 year intervals, influence the ecological communities in these systems (Hansen et al. 1995). Each year seeds from annuals and perennials germinate and cover exposed mud flats, but when precipitation floods the depressions, the annuals drown and the perennials survive. Over a series of years the perennials dominate. The drawdown to mudflats is necessary so that emergent vegetation can become reestablished. This flooding, drawdown and the eventual exposure of mud flats drive the water-level vegetation cycle.

Management
Changes will occur in the plant communities due to climatic conditions and/or management actions. Due to the nature of the soils, these sites are considered moderately resilient. With continued adverse impacts, a moderate decline in vegetative vigor and composition will occur. Heavy continuous grazing and/or continuous seasonal (spring) grazing, without adequate recovery periods will eventually lead to loss of the Western wheatgrass-foxtail barley wetland community, and inland saltgrass will begin to increase. Western wheatgrass will increase initially, but then will begin to decrease. In time, heavy continuous grazing will cause inland saltgrass, fowl bluegrass (*Poa palustris*), and other pioneer perennials and annuals to increase. This replacement plant community is resistant to change, due to the grazing tolerance of inland saltgrass and increased surface salts. However, a significant amount of production and diversity has been lost compared to the Western wheatgrass -foxtail barley community, and the loss of key cool season grasses and increased bare ground will affect energy flow and nutrient cycling. Water infiltration will be reduced significantly due to the massive shallow root system "root pan" characteristic of inland saltgrass, and the increased amount of bare ground. It will take a long time to bring this plant community back with management alone (USDA NRCS, 2003).

Restoration Considerations
The major barriers to restoration are isolation, infrequent flooding, impermeable soils and invasive species. These factors must be addressed during the planning and long term management of restored wetlands.

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Western Great Plains Open Freshwater Depression Wetland

General Description
This Great Plains system occurs in lowland depressions and along lake borders with open basins and a permanent water source through most of the year. This system is distinguished from the Western Great Plains Closed Depression Wetlands by having a larger watershed and/or significant connection to the groundwater table. Soils are typically Mollisols, Entisols or occasionally Histosols. Soil pH varies from neutral to slightly alkaline. In Montana, this system is especially well represented along major and secondary tributaries of the Milk, Marias and Two Medicine rivers in the northwestern Great Plains glaciated pothole region. Throughout Montana, most sites within this system are found at elevations of 664-2,027 meters (2,180-6,650 feet). Species diversity can be high in some occurrences. These wetlands usually contain emergent graminoids such as cattails (*Typha* species)*,* sedges (*Carex* species), spikerushes (*Eleocharis* species), rushes *(Juncus* species) and bulrushes (*Schoenoplectus* species), as well as floating vegetation such as pondweeds (*Potamogeton* species), arrowhead *(Sagittaria* species), or common hornwort (*Ceratophyllum demersum*). At montane elevations, these systems can be moderately complex with a variety of species and communities. Increased grazing pressure in and adjacent to these systems will change the plant communities that are present. In semi-permanent systems, the drawdown zone is typically dominated by beaked sedge (*Carex utriculata*) water sedge (*Carex aquatilis*), and Nebraska sedge (*Carex nebrascensis*). In seasonal ponds that draw down annually, and in semipermanent wetlands during drought years, buried seeds of both annuals and perennials will germinate in exposed mud flats.

Diagnostic Characteristics
Herbaceous, depression, depressional, saturated soils, partially isolated

Range
This system occurs across the western Great Plains from North Dakota and Kansas west to Montana and south to Texas. This system can occur throughout the western Great Plains but is likely more prevalent in the south-central portions of the division. Its distribution extends into central Montana, where it occurs in the matrix of the Northwestern Great Plains Mixed Grass Prairie. However, these depressions are most concentrated to the north of the Hi-Line and Route 2, from the Blackfeet Reservation to the North Dakota border. Individual depressions can also be found across the Northwest Glaciated Plains north of the Missouri River.

Environment
Open depression wetlands are found throughout the Northwestern Glaciated Great Plains region of Montana. They form in lowlands, and along lake borders and stream margins. They generally have more open basins, a large watershed, and a permanent water source throughout most of the year, except during exceptional drought years. This system differs from closed depressional wetlands by having a larger watershed and/or significant connection to the groundwater table (Cook and Hauer 2007). In Montana, most sites within this system are found at elevations of 664-2,027 meters (2,180-6,650 feet). Soils are typically Mollisols, Entisols or occasionally Histosols. Soil pH varies from neutral to slightly alkaline.

Vegetation
Open depression wetlands often have submerged aquatic plants in the open water zone including common hornwort (*Ceratophyllum demersum*), short spikewater milfoil *(Myriophyllum sibiricum*), and horned pondweed (*Zannichellia palustris*) as well as floating-leaved plants including pondweeds (*Stuckenia* and *Potamogeton* species), white water crowfoot (*Ranunculus aquatilis*) and arrowheads (*Sagittaria* species). The central marsh zone is typically dominated by hardstem bulrush (*Schoenoplectus acutus*), but softstem bulrush (*Schoenoplectus tabernaemontani*), common threesquare (*Schoenoplectus pungens*) and alkali bulrush (*Schoenoplectus maritimus*), often co-dominate. Also found in the marsh zone are cattails (*Typha* species), water knotweed (*Polygonum amphibium*), and hemlock water parsnip (*Sium suave*). The seasonally flooded zones are typically dominated by graminoids including common spikerush *(Eleocharis palustris*), needle spikerush (*Eleocharis acicularis*), American sloughgrass (*Beckmannia syzigachne*), wheat sedge (*Carex atherodes*), foxtail barley (*Hordeum jubatum*), shortawn foxtail (*Alopecurus aequalis*), and water foxtail (*Alopecurus geniculatus*). Open depressional systems are often bordered by wet prairie zones characterized by species such as slimstem reedgrass (*Calamagrostis stricta*), clustered field sedge (*Carex praegracilis*), bluejoint (*Calamagrostis canadensis*) and fowl bluegrass (*Poa palustris*). Open depressions with more alkaline or saline water and soil chemistry will typically be bordered by species such as saltgrass (*Distichlis spicata)*, western wheatgrass (*Pascopyrum smithii)*, and freshwater cordgrass (*Spartina pectinata)*. Sites that have been moderately grazed often have an increase in Baltic rush (*Juncus balticus*), knotted rush (*Juncus nodosus*), foxtail barley (Hordeum jubatum), American sloughgrass (*Beckmannia syzigachne*), and western wheatgrass (*Pascopyrum smithii*).

Dynamic Processes
These systems developed under Northern Great Plains climatic conditions, and experienced the natural influence of large herbivores, periodic flooding events and occasional fire. Wet-drought year climatic cycles in Montana, often in 10 to 20 year intervals, influence the ecological communities (Hansen et al., 1995). Seeds from annuals and perennials germinate and cover exposed mud flats, but when precipitation floods the depressions, the annuals drown and the perennials survive. Over a series of years the perennials dominate. The drawdown to mudflats is necessary so that emergent vegetation can become reestablished. Flooding, drawdown and the eventual exposure of mud flats drive the water-level vegetation cycle. Species richness can vary considerably among individual examples and is especially influenced by adjacent land use. Agriculture may provide nutrient and herbicide runoff. In saline soil wetlands, the increase in precipitation during exceptionally wet years can dilute the salt concentration in the soils, which may allow for less salt-tolerant species to occur.

Management
Changes will occur in the plant communities due to climatic conditions and/or management activities. Conversion to agriculture and pastureland can impact this system when it alters the hydrology of the system.

Restoration Considerations
In open depression wetland systems where water has been drained or diverted, the original hydrology of the system must be restored. If water levels are restored, re-growth and re-colonization from dormant rhizomatous root systems of common emergent species can occur within a few years. Livestock grazing should be controlled to allow regrowth, recolonization and re-sprouting from existing root systems. Many of the characteristic species found in these systems are rhizomatous, and exhibit excellent erosion control properties. In some cases, if hydric soils are heavily altered due to pugging or compaction, addition of organic material may be needed to facilitate vegetation recolonization.

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Great Plains Prairie Pothole

General Description
Prairie potholes occur in shallow depressions scraped out by glaciers in the northern Great Plains of Montana. The region is characterized by a glacial landscape of end moraines, stagnation moraines, outwash plains and lake plains. The glacial drift forms steep to slight local relief with fine-grained, silty to clayey soils. Limestone, sandstone, and shales are the predominant parent materials, and highly mineralized water can discharge from these rocks. The hydrology of this system is complex, and the concentration of dissolved solids results in water that ranges from fresh to extremely saline, with chemical characteristics varying seasonally and annually. Most prairie potholes and associated lakes contain alkaline water, which accumulates rapidly in during spring months, especially when soil frost is sufficiently deep to forestall all infiltration until after the ground thaws. Most water loss occurs through evapotranspiration, which exceeds precipitation during summer months. Vegetation within this system is highly influenced by hydrology, salinity and dynamics. Potholes can vary in depth and duration, which determines the local gradient of plant species. Similarly, species found within individual potholes will be strongly influenced by periodic drought and wet periods. The wettest sites, where water stands through summer, are characterized by hardstem bulrush (*Schoenoplectus acutus*), often occurring as a near monoculture, or with softstem bulrush (*Schoenoplectus tabernaemontani*) or common threesquare (*Schoenoplectus pungens)* along slightly drier margins. In permanently flooded sites, aquatic buttercups (*Ranunculus* species), aquatic smartweeds (*Polygonum* species), pondweeds (*Potamogeton* species) or duckweeds (*Lemna* species) are common. At the drier extremes, pothole vegetation generally occurs in a concentric pattern from a wetter middle dominated by

spikerush (*Eleocharis* species) through a drier ring of foxtail barley (*Hordeum jubatum*) and an outer margin of western wheatgrass (*Pascopyrum smithii*) or thickspike wheatgrass (*Elymus lanceolatus*). Prairie potholes are considered to be the most important breeding habitat for waterfowl in North America, with production estimates ranging from 50% to 80% of the continent's main species. However, the extreme variability in climate and pothole water levels also results in extreme fluctuations in waterfowl populations from year to year. Prairie pothole wetlands also support a diverse assemblage of water-dependent birds.

Diagnostic Characteristics
lowland, herbaceous depressional, pothole, isolated wetland, temperate

Range
In Montana, most prairie potholes are concentrated north of the HiLine and Route 2, from the Blackfeet Reservation to the North Dakota border, although individual potholes occur across the Northwest Glaciated Plains north of the Missouri River. Elsewhere, this system occurs throughout the northern Great Plains from central Iowa northeast to southern Saskatchewan and Alberta. It encompasses approximately 870,000 square kilometers with approximately 80% of its range in southern Canada. It is also prevalent in North Dakota, South Dakota, and northern Minnesota.

Environment
The prairie pothole ecological system is dominated by closed basins that receive irregular inputs of water from the surroundings and export water as groundwater. The climate is characterized by mid-continental temperature and precipitation extremes. The region is distinguished by a thin mantle of glacial drift with overlying stratified sedimentary rocks of the Mesozoic and Cenozoic ages; these form a glacial landscape of end moraines, stagnation moraines, outwash plains and lake plains. The glacial drift is from 30 meters to 120 meters thick and forms steep to slight local relief with fine-grained, silty to clayey soils. Limestone, sandstone, and shales are predominant, and highly mineralized water can discharge from these rocks. Precipitation and runoff from snowmelt are often the principal water sources, with groundwater inflow as a secondary source. Evapotranspiration is the primary source of water loss, with seepage loss secondary. The hydrology of this system is complex, and the concentration of dissolved solids results in water that ranges from fresh to extremely saline, with chemical characteristics varying seasonally and annually. Most prairie potholes and associated lakes contain water that is alkaline (pH >7.4). Surrounding uplands are generally in cropland (small grains), hay, or range.

Prairie potholes are considered to be the most important breeding habitat for waterfowl in North America, with production estimates ranging from 50% to 80% of the continent's main species. However, the extreme variability in climate and pothole water levels also results in extreme fluctuations in waterfowl populations from year to year. Prairie wetlands also support a diverse assemblage of water-dependent birds including Montana species of concern such as the Black-crowned Night-Heron (*Nycticorax nycticorax*), White-faced Ibis (*Plegadis chihi*), Franklin's Gull (*Larus pipixcan*), Common Tern (*Sterna hirundo*), Forster's Tern (*Sterna forsteri*), and Black Tern (*Chlidonias niger*). American White Pelicans (*Pelecanus erythrorhynchos*) feed extensively on tiger salamanders (*Ambystoma tigrinum*) found in prairie potholes. Sparsely-vegetated alkali potholes, especially in Sheridan County, are attractive to Piping Plovers *(Charadrius melodus*).

Vegetation
Vegetation within this system is highly influenced by hydrology, salinity and dynamics. This system includes elements of emergent marshes and wet, sedge meadows that develop into a pattern of concentric rings. Potholes can vary in depth and duration, which determines the local gradient of species. Similarly, plant species found within individual potholes will be strongly influenced by periodic drought and wet periods. The wettest sites, where water stands into or through summer, are characterized by hardstem bulrush (*Schoenoplectus acutus*), often occurring as a near monoculture, or with a fringe of softstem bulrush (*Schoenoplectus tabernaemontani*) or common threesquare (*Schoenoplectus pungens)* along slightly drier margins. Cattails (*Typha* spp.) are also seen in these wetter systems, although they are typically a minor component. During spring or in permanently flooded sites, aquatic buttercups (*Ranunculus* species), aquatic smartweeds (*Polygonum* species), pondweeds (*Potamogeton* species) or duckweeds (*Lemna* species) may be abundant. At the drier extremes, pothole vegetation generally occurs in a concentric pattern from a wetter middle dominated by spikerush (*Eleocharis* species) through a drier ring of foxtail barley (*Hordeum jubatum*) and an outer margin of western wheatgrass (*Pascopyrum smithii*) or thickspike wheatgrass (*Elymus lanceolatus*) (Hansen et al. 1996, Lesica 1989). Grazing, draining, and mowing of this system can influence vegetation distribution.

Dynamic Processes
Flooding is the primary natural dynamic influencing this system. Snowmelt in the spring often floods this system and can cause the prominent potholes within the system to overflow. Greater than normal precipitation can flood out emergent vegetation and/or increase herbivory by animal species such as muskrats. Periodic wet and droughty periods cause shifts in vegetation. Vegetation zones are evident, and each zone responds to changing environmental conditions. Draining and conversion to agriculture can also significantly impact this system. Much of the original extent of this system has been converted to cropland, and many remaining examples are under pressure to be drained.

Management
Livestock use of potholes is limited by low palatability of characteristic species, although open water attracts livestock for both drinking and cooling. When upland vegetation becomes sparse, cattle will graze on spikerush and bulrush. Wet soils are easily trampled. Grazing, when properly planned and executed, can be a management tool, preventing cattail encroachment into open water, limiting the spread of exotics such as crested wheat (*Agropyron cristatum*) and smooth brome (*Bromus inermis*), and avoiding excessive litter buildup. Prescribed burning can be used to the same ends. Prairie potholes are primarily threatened by crop agriculture, by unrestricted grazing, and by oil and gas development. Region-wide, nearly half of this system has been lost.

Restoration Considerations
In Great Plains prairie pothole wetland systems where water has been drained or altered, the original hydrology of the system must be restored. If water levels are restored, re-growth and re-colonization from dormant rhizomatous root systems of common emergent species can occur within a few years. Many of the characteristic species found in marsh systems are rhizomatous, thus exhibit excellent erosion control properties. However, species that are infrequent in these wetland systems may not re-occur or re-establish in a given time frame. The major barriers to

prairie pothole restoration are isolation, infrequent flooding and invasive species. These factors must be addressed during the planning and long term management of restored prairie pothole wetlands.

During restoration, cattle grazing needs to eliminated or controlled to allow regrowth, recolonization and resprouting from existing root systems. In some cases, if hydric soils are heavily altered due to pugging or compaction, addition of organic material may be needed to facilitate plant recolonization.

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Great Plains Saline Depression Wetland

General Description

This ecological system is very similar to both the Western Great Plains Open Freshwater Depression Wetland and the Western Great Plains Closed Depression Wetland found in wetland complexes in the central and northeastern portion of Montana. However, this system differs due to increased soil salinity, which causes these systems to become brackish. This high salinity is attributed to high evaporation and the accumulation of minerals dissolved in the water. Wetlands in this system are discharge wetlands, where water high in dissolved salts has moved from the regional groundwater system into the depression. Hydroperiods vary depending on precipitation and snowmelt, the primary source of water. Water is prevented from percolating out of the depression due to impermeable dense clay, and salt encrustations can occur on the surface with drying. Species that typify this system are salt-tolerant and halophytic graminoids such as alkali bulrush (*Schoenoplectus maritimus*), common three square (*Schoenoplectus pungens*), inland saltgrass (*Distichlis spicata*), Nuttall's alkali grass (*Puccinellia nuttalliana)*, foxtail barley (*Hordeum jubatum*), red swampfire (*Salicornia rubra*) and freshwater cordgrass (*Spartina pectinata*), and shrubs such as black greasewood (*Sarcobatus vermiculatus)*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils in some cases, allowing for less salt-tolerant species to occur. The distribution of this system extends into central Montana, where it occurs in the matrix of the Northwestern Great Plains Mixed Grass Prairie. However, these depressions are most concentrated to the north of the HiLine and Route 2, from the Blackfeet Reservation to the North Dakota Border. Individual occurrences can also be found across the Northwest Glaciated Plains north of the Missouri River.

Diagnostic Characteristics
Isolated to partially isolated wetland, depression, saline conditions

Range
This system can occur throughout the western Great Plains but is more prevalent in the south-central portions of the division. Its distribution extends into central Montana where it occurs in the matrix of the Northwestern Great Plains Mixed Grass Prairie. These saline depressions are most concentrated to the north of the HiLine and Route 2, from the Blackfeet Reservation to the North Dakota Border. Individual depressions can also be found across the Northwestern Glaciated Plains north of the Missouri River.

Environment
This system is distinguished from the freshwater depression systems by brackish water caused by strongly saline and alkaline soils. This high salinity is attributed to excessive evaporation and the accumulation of minerals dissolved in groundwater discharge. Water is prevented from percolating out of the depression due to an impermeable dense clay soil. Salt encrustations can occur on the surface due to slow water movement (Hansen et al, 1996). On the Blackfeet Indian reservation, water samples collected from saline depressions had conductivity values that ranged from 1,550-40,000 uhmos/cm (Lesica and Shelley, 1988).

Vegetation
Vegetation within this system is highly influenced by soil salinity and soil moisture. Salt-tolerant and halophytic species that typify this system include alkali bulrush (*Schoenoplectus maritimus*), common three square (*Schoenoplectus pungens*), inland saltgrass (*Distichlis spicata*), Nuttall's alkali grass (*Puccinellia nuttalliana*), foxtail barley (*Hordeum jubatum)*, red swampfire (*Salicornia rubra)* and freshwater cordgrass (*Spartina pectinata*), and shrubs such as black greasewood (*Sarcobatus vermiculatus*). Other species include western wheatgrass (*Pascopyrum smithii)* and foxtail barley (*Hordeum jubatum*). Plant zonation related to soil salinity is often apparent in these systems with distinct rings occurring around the fringe of the depression. In deeper, more depressed halophytic habitats, red swampfire or prairie cordgrass will dominate with Nuttall's alkali grass found directly upslope, followed by inland saltgrass. Shrubs such as greasewood and winterfat (*Krascheninnikovia lanata*) are common around the outer margins of this system. Pursh seepweed (*Suaeda calceoliformis*), annual goosefoot (*Chenopodium* species) and seaside arrowgrass (*Triglochin maritima*) are common forbs.

In northeastern Montana, the alkali bulrush association occurs as an emergent band around open water or as zonal vegetation around other plant associations. Water tables are often high, often remaining above the soil surface at least through late summer. Soils are poorly drained, alkaline Entisols. Alkali bulrush forms dense, monotypic stands with up to 91% cover. In some areas along the wetland edge, very minor amounts of common spikerush (*Eleocharis palustris*) may be present. Alkali bulrush can survive periods of total inundation up to 1 meter (3.3 feet) deep, as well as drought periods where the water table remains less than 1 meter below the soil surface. It is a vigorously rhizomatous species that colonizes and spreads when the water table is within 10 centimeters (4 inches) of the surface. Cover of alkali bulrush may be replaced by red swampfire and other associated species during drought years.

Red swampfire occurs in the drawdown zone that is flooded during the early part of the growing season but where the water table drops below soil surface by late spring or early summer. Soils in this zone usually have silty-clay to clay texture, and the soil surface is covered with salt crusts. Principle salts are sulfates and chlorides of sodium and magnesium. It is one of a very few species that can persist in these hyper-saline conditions when the water table drops below the soil surface (Dodd and Coupland 1966).

Dynamic Processes

These systems developed under Northern Great Plains climatic conditions that include natural influence of periodic flooding events and occasional fire. Climate has an important effect on saline areas because precipitation and snowmelt transport salts to the depressions and can dilute the soil solution while temperature and wind influence the rate of evapotranspiration. Increased precipitation and/or runoff can dilute the salt concentration and allow for less salt-tolerant species to occur while increased evapotranspiration increases soil salinity leading to a more brackish habitat type.

Management

Changes will occur in the plant communities due to climatic conditions and/or management activities.

Restoration Considerations

In saline depression wetland systems where water has been drained or altered, the original hydrology of the system must be restored. If hydrology is restored, re-growth and re-colonization from dormant rhizomatous root systems of common emergent species can occur during periods of flooding. Cattle grazing should be deferred or controlled to allow regrowth, recolonization and resprouting from existing root systems. Annuals such as red swampfire and annual goosefoots require periods of inundation and drawdown to initiate germination and to complete their life cycles at the end of the growing season.

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Western North American Emergent Marsh

General Description

This widespread wetland system occurs throughout the arid and semi-arid regions of North America. In Montana, this system is typically found in depressions surrounded by an upland matrix of mixed prairie, shrub steppe, or steppe vegetation. Natural marshes occur in and adjacent to ponds and prairie potholes, as fringes around lakes or oxbows, and along slow-flowing streams and rivers as riparian marshes. Marshes are classified as either seasonal or semipermanent based on the dominant vegetation found in the deepest portion of the wetland; vegetation is representative of the hydroperiod. A central shallow marsh zone dominated by graminoids and sedges characterizes seasonal wetlands, while semipermanent wetlands are continually inundated, with water depths up to 2 meters (6.5 feet) and a deeper central marsh zone dominated by cattails (*Typha* species) and bulrushes (*Schoenoplectus* species). Water chemistry may be alkaline or semi-alkaline, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils characteristics reflect long periods of anaerobic conditions. Dominant vegetation often includes western wheatgrass (*Pascopyrum smithii*), Northwest Territory sedge (*Carex utriculata*), Nebraska sedge (*Carex nebrascensis*), broadleaf cattail (*Typha latifolia*), and hardstem bulrush (*Schoenoplectus acutus*). Alkaline marsh communities include western wheatgrass, fresh water cordgrass (*Spartina pectinata*), and seashore saltgrass (*Distichlis spicata*).

Diagnostic Characteristics
Herbaceous, depressional, mineral with A horizon greater than 10 cm, aquatic herb, deep water greater than 15 cm, saturated soil

Range
This wetland ecological system occurs throughout western North America. In Montana, it is system is found throughout the state at foothill to upper montane elevations.

Environment
This system is found in environments where precipitation is approximately 25 to 50 centimeters (10 to 20 inches) per year. In Montana, this system is typically found in depressions surrounded by an upland matrix of mixed prairie, shrub steppe, steppe vegetation and forests near the mountains. Natural marshes occur in and adjacent to ponds and prairie potholes, as fringes around lakes or oxbows, and along slow-flowing streams and rivers as riparian marshes. Water chemistry may be alkaline or semi-alkaline, but is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils characteristics reflect long periods of anaerobic conditions, with gleying, high organic content, and redoximorphic features. Wetland marshes are classified as either seasonal or semi-permanent based on the dominant vegetation found in the deepest portion of the wetland (Stewart and Kantrud 1971 and LaBaugh et al. 1996). Vegetation communities occurring in these marsh systems is representative of their hydroperiod; some basins dry to bare soil after seasonal flooding, while others will have a variety of wetland types in a zoned pattern dependent on seasonal water table depths and salt concentrations (Kudray and Cooper 2006).

Vegetation
Vegetation communities change according to wet-drought cycles. In seasonal ponds that dry out annually, and in semipermanent wetlands during drought years, buried seeds of both annuals and perennials germinate, covering exposed mud flats (Hansen et al. 1995). In semi-permanent marshes, the drawdown zone is typically dominated by western wheat grass (*Pascopyrum smithii)* near the upland edge, with Northwest Territory sedge (*Carex utriculata*) and Nebraska sedge (*Carex nebrascensis*) as the dominant sedges located down gradient, and broadleaf cattail (*Typha latifolia*) and hardstem bulrush (*Schoenoplectus acutus*) located in the deeper, central portion of the marsh. Water sedge (*Carex aquatilis*) is frequently co-dominant with Northwest Territory sedge. Less commonly, blister sedge (*Carex vesicaria*) and awned sedge (*Carex atherodes*) are intermixed with Northwest Territory sedge or occur as co-dominants on similar sites. Beyond the emergent vegetation, floating-leaved hydrophytes may be present in wetter sites with longer inundation periods, including water lilies (*Nymphaea* species), yellow pondlily (*Nuphar* species), buttercup (*Ranunculus* species) and pondweed (*Potamogeton* species). Other floating species may be present in shallow water, such as duckweed, (*Lemna* species), and submergents such as common hornwort (*Ceratophyllum demersum*), horned pondweed (*Zannichellia palustris*), mare's tail (*Hippuris vulgaris*) and water milfoil (*Myriophyllum* species).

Seasonal marshes are typically dominated by western wheat grass (*Pascopyrum smithii*), beaked sedge (*Carex utriculata*), inflated sedge (*Carex vesicaria*), Nebraska sedge (*Carex nebrascensis*), creeping spikerush (*Eleocharis palustris*), Baltic rush (*Juncus balticus*) and cattail (*Typha latifolia* or *angustifolia*). During wetter years, annuals disappear and marshes become dominated by

emergent perennials. Common perennial forbs include common willow herb (*Epilobium ciliatum*), marsh cinquefoil (*Potentilla palustris*), Gmelin's buttercup (*Ranunculus gmelinii*), greater creeping spearwort (*Ranunculus flammula*), hemlock water parsnip (*Sium suave*), willow dock (*Rumex salicifolius*), field mint (*Mentha arvensis),* leafy aster (*Symphyotrichum foliaceum)* and broadleaf arrowhead (*Sagittaria latifolia*). Fern allies such as water horsetail (*Equisetum fluviatile*) and field horsetail (*Equisetum arvense*) often form significant cover within seasonal marshes. Grasses common to marshes include small floating mannagrass (*Glyceria borealis*), tufted hairgrass (*Deschampsia caespitosa*), and bluejoint reedgrass (*Calamagrostis canadensis*).

Seasonal and semi-permanent marshes with more alkaline water chemistry are commonly found throughout central and eastern Montana. Typical species include hardstem bulrush, cattail, common threesquare (*Schoenoplectus pungens*), alkali bulrush (*Shoenoplectus maritimus*) and inland saltgrass (*Distichlis spicata*), red swampfire (*Salicornia rubra*) and prairie cordgrass (*Spartina pectinata*) in adjacent drawdown zones. These marsh communities are brackish and support species adapted to saline and alkaline water and soil conditions, similar to Western Great Plains Saline Depression systems.

Typically, riverine marshes subjected to unaltered, seasonal water flow and annual flooding are characterized by zonal vegetation determined by water depth with stands of bulrush (*Schoenoplectus* species), softstem bulrush (*Schoenoplectus tabernaemontani*), and cattail in deeper water, and manna grass (*Glyceria* species), water sedge, inflated sedge, water horsetail and common spikerush in shallower water zones. Riverine marshes can be influenced by beaver activity and human caused influences that can change the structure and species richness of these plant communities. Beaver activity can increase species richness and diversify community structure by altering water flow, depth, and organic sediment accumulation.

Dynamic Processes

Wet-drought year climatic cycles in Montana, often in 10 to 20 year cycles, influence the ecological communities in these systems (Hansen et al., 1995). During this climatic cycle, wetlands go through a dry marsh, regenerating marsh, degenerating marsh and a lake phase that is regulated by periodic drought and deluge (Mitsch and Gosselink, 2000). During drought periods, seeds from annuals and perennials germinate and cover exposed mud flats, but when precipitation floods the depressions, the annuals drown and the perennials survive, regenerating the marsh. Over a series of years, perennials dominate and submersed and floating-leaved hydrophytes return. After a few years of the regenerating phase, emergent vegetation begins to decline and eventually the marsh reverts to an open water system. Muskrats may play an important role in the decline of emergent vegetation in some of these systems. During drought, the drawdown to mudflats is necessary so that emergent vegetation can become reestablished. Flooding, drawdown and the eventual exposure of mud flats drive the water-level vegetation cycle. In saline soil marshes, increase in precipitation during exceptionally wet years can dilute the salt concentration in the soils, allowing for less salt-tolerant species to occur.

Species richness can vary considerably among individual examples and is especially influenced by adjacent land use. Agriculture and forestry operations, when adjacent, may cause nutrient and herbicide runoff.

Management
Changes will occur in the plant communities due to climatic conditions and/or management activities. Draining, ditching or conversion to agriculture and pastureland can alter the hydrology of the system. Moderate to Heavy grazing practices can greatly decrease cover of beaked sedge, and cause soil compaction. Invasive and exotic species such as reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*) and Canadian thistle (*Cirsium arvense*) become established in areas of heavy grazing or other disturbances. Diversion or lateration of seasonal flooding in riverine systems can change the species composition and successional direction of riverine marsh communities.

Restoration Considerations
In marsh systems where water has been drained or altered, the original hydrology of the system must be restored. If water levels are restored, re-growth and re-colonization from dormant rhizomatous root systems of common marsh species can occur within a few years. Cattle grazing must be eliminated or controlled to allow regrowth, recolonization and resprouting from existing root systems. Many of the characteristic species found in marsh systems are rhizomatous, thus exhibit excellent erosion control properties. In some cases, if hydric soils are heavily altered due to pugging or compaction, addition of organic material may be needed to facilitate vegetation recolonization.

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APPENDIX B. ECOLOGICAL SYSTEM FIELD KEY

Field Key to Wetland and Riparian Ecological Systems of Montana

1a. Wetland defined by groundwater inflows and peat (organic soil) accumulation of at least 40cm (unless underlain by bedrock). Vegetation can be woody or herbaceous. If the wetland occurs within a mosaic of non-peat forming wetland or riparian systems, then the patch must be at least 0.1 hectares (0.25 acres). If the wetland occurs as an isolated patch surrounded by upland, then there is no minimum size criteria..**Rocky Mountain Subalpine-Montane Fen**

1b. Wetland does not have at least 40 cm of peat (organic soil) accumulation or occupies an area less than 0.1 hectares (0.25 acres) within a mosaic of other non-peat forming wetland or riparian systems **2**

2a. Total woody canopy cover generally 25% or more within the overall wetland/riparian area. Any purely herbaceous patches are less than 0.5 hectares and occur within a mosaic of woody vegetation. Note: Relictual woody vegetation such as standing dead trees and shrubs are included here ....**GO TO KEY A: Woodland and Shrubland Ecological Systems**

2b. Total woody canopy cover generally less than 25% within the overall wetland/riparian area. Any woody vegetation patches are less than 0.5 hectares and occur within a mosaic of herbaceous wetland vegetation ....**GO TO KEY B: Herbaceous Ecological Systems**

KEY A: Woodland and Shrubland Ecological Systems

1a. Woody wetland associated with any stream channel, including ephemeral, intermittent, or perennial (Riverine HGM Class)...**2**

1b. Woody wetland associated with the discharge of groundwater to the surface or fed by snowmelt or precipitation. This system often occurs on slopes, lakeshores, or around ponds. Sites may experience overland flow but no channel formation. (Slope, Flat, Lacustrine, or Depressional HGM Classes)...**8**

2a. Riparian woodlands and shrublands of the montane or subalpine zone **3**

2b. Riparian woodlands and shrublands of the plains, foothills, or lower montane zone **4**

3a. Montane or subalpine riparian woodlands (canopy dominated by trees), occurring as a narrow streamside forest lining small, confined low- to mid-order streams. Common tree species include *Abies lasiocarpa*, *Picea engelmannii*, *Pseudotsuga menziesii*, and *Populus tremuloides*............................ **Rocky Mountain Subalpine-Montane Riparian Woodland**

3b. Montane or subalpine riparian shrublands (canopy dominated by shrubs with sparse tree cover), occurring as either a narrow band of shrubs lining the streambank of steep V-shaped canyons *or* as a wide, extensive shrub stand (sometimes referred to as a shrub carr) on alluvial terraces in low-gradient valley bottoms. Beaver activity is common within the wider occurrences. Species of *Salix*, *Alnus*, or *Betula* are typically dominant ....**Rocky Mountain Subalpine-Montane Riparian Shrubland**

4a. Riparian woodlands and shrublands of the foothills or lower montane zones of the Northern and Middle Rockies and the Wyoming Basin **5**

4b. Riparian woodlands and shrublands of the Northwestern or Western Great Plains of eastern Montana...**6**

5a. Foothill or lower montane riparian woodlands and shrublands associated with mountain ranges of the Northern Rockies in northwestern Montana. This type *excludes* island mountain ranges east of the Continental Divide in Montana. *Populus balsamifera* ssp. *trichocarpa* is typically the canopy dominant in woodlands. Other common tree species include *Populus tremuloides*, *Betula papyrifera*, *Betula occidentalis*, and *Picea glauca*. Shrub understory species include *Cornus sericea*, *Acer glabrum*, *Alnus incana*, *Oplopanax horridus*, and *Symphoricarpos albus*. Areas of riparian shrubland and open wet meadow are common .... **Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland**

5b. Foothill or lower montane riparian woodlands and shrublands associated with mountain ranges of the Middle Rockies and the Wyoming Basin. This type also includes island mountain ranges in central and eastern Montana. Woodlands are dominated by *Populus* spp. including *Populus angustifolia*, *Populus balsamifera* ssp. *trichocarpa*, *Populus deltoides*, and *Populus fremontii*. Common shrub species include *Salix* spp., *Alnus incana*, *Crataegus* spp., *Cornus sericea*, and *Betula occidentalis* .... **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland**

6a. Woodlands and shrublands of draws and ravines associated with permanent or ephemeral streams, steep north-facing slopes, or canyon bottoms that do not experience flooding. Common tree species include *Fraxinus* spp., *Acer negundo*, *Populus tremuloides*, and *Ulmus* spp. Important shrub species include *Crataegus* spp., *Prunus virginiana*, *Rhus* spp., *Rosa woodsii*, *Symphoricarpos occidentalis*, and *Shepherdia argentea* .... **Western Great Plains Wooded Draw and Ravine**

6b. Woodlands and shrublands of small to large streams and rivers of the Northwestern or Western Great Plains. Overall vegetation is lusher than above and includes more wetland indicator species. Dominant species include *Populus balsamifera* ssp. *trichocarpa*, *Populus deltoides*, and *Salix* spp. **7**

7a. Woodlands and shrublands of riparian areas of medium and small rivers and streams with little or no floodplain development and typically flashy hydrology .... **Northwestern/Western Great Plains Riparian**

7b. Woodlands and shrublands of riparian areas along medium and large rivers with extensive floodplain development and periodic flooding ...... **Northwestern/Western Great Plains Floodplain**

8a. Woody wetland associated with small, shallow ponds in northwestern Montana. Ponds are ringed by trees including *Populus balsamifera* ssp. *trichocarpa*, *Populus tremuloides*, *Betula papyrifera*, *Abies grandis*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, and *Pseudotsuga menziesii*. Typical shrub species include *Cornus sericea*, *Amelanchier alnifolia*, and *Salix* spp... **Northern Rocky Mountain Wooded Vernal Pool**

8b. Woody wetland associated with the discharge of groundwater to the surface, or sites with overland flow but no channel formation **9**

9a. Coniferous woodlands associated with poorly drained soils that are saturated year round or seasonally flooded. Soils can be woody peat but tend toward mineral. Common tree species include *Thuja plicata*, *Tsuga heterophylla*, and *Picea engelmannii*. Common species of the herbaceous understory include *Mitella* spp., *Calamagrostis* spp., and *Equisetum arvense* .... **Northern Rocky Mountain Conifer Swamp**

9b. Woody wetlands dominated by shrubs **10**

10a. Subalpine to montane shrubby wetlands that occur around seeps, fens, and isolated springs on slopes away from valley bottoms. This system can also occur within a mosaic of multiple shrub- and herb-dominated communities within snowmelt-fed basins. This example of the system has the same species composition as the riverine example of this system and is dominated by species of *Salix*, *Alnus*, or *Betula*..**Rocky Mountain Subalpine-Montane Riparian Shrubland**

10b. Lower foothills to valley bottom shrublands restricted to temporarily or intermittently flooded drainages or flats and dominated by *Sarcobatus vermiculatus*...**Inter-Mountain Basins Greasewood Flat**

KEY B: Herbaceous Wetland Ecological Systems

1a. Herbaceous wetlands of the Northwestern Glaciated Plains, Northwestern Great Plains, or Western Great Plains regions of eastern Montana..**2**

1b. Herbaceous wetlands of other regions...**5**

2a. Wetland occurs as a complex of depressional wetlands within the glaciated plains of northern Montana. Typical species include *Schoenoplectus* spp. and *Typha latifolia* on wetter, semi-permanently flooded sites, and *Eleocharis* spp., *Pascopyrum smithii*, and *Hordeum jubatum* on drier, temporarily flooded sites .... **Great Plains Prairie Pothole**

2b. Wetland does not occur as a complex of depressional wetlands within the glaciated plains of Montana **3**

3a. Depressional wetlands in the Western Great Plains with saline soils. Salt encrustations can occur on the surface. Species are typically salt-tolerant such as *Distichlis spicata*, *Puccinellia* spp., *Salicornia* spp., and *Schoenoplectus maritimus* .... **Western Great Plains Saline Depression Wetland**

3b. Depressional wetlands in the Western Great Plains with obvious vegetation zonation dominated by emergent herbaceous vegetation, including *Eleocharis* spp., *Schoenoplectus* spp., *Phalaris arundinacea*, *Calamagrostis canadensis*, *Hordeum jubatum*, and *Pascopyrum smithii*..**4**

4a. Depressional wetlands in the Western Great Plains associated with open basins that have an obvious connection to the groundwater table. This system can also occurs along stream margins where it is linked to the basin via groundwater flow. Typical plant species include species of *Typha*, *Carex*, *Schoenoplectus*, *Eleocharis*, *Juncus*, and floating genera such as *Potamogeton*, *Sagittaria*, and *Ceratophyllum* .... **Western Great Plains Open Freshwater Depression Wetland**

4b. Depressional wetlands in the Western Great Plains primarily within upland basins having an impermeable layer such as dense clay. Recharge is typically via precipitation and runoff, so this system typically lacks a groundwater connection. Wetlands in this system tend to have standing water for a shorter duration than Western Great Plains Open Freshwater Depression Wetlands. Common species include *Eleocharis* spp., *Hordeum jubatum*, and *Pascopyrum smithii*...................... **Western Great Plains Closed Depression Wetland**

5a. Depressional wetlands occurring in areas with alkaline to saline clay soils with hardpans. Salt encrustations can occur on the surface. Species are typically salt-tolerant such as *Distichlis spicata*, *Puccinellia* spp., *Leymus* sp., *Poa secunda*, *Salicornia* spp., and *Schoenoplectus maritimus*. Communities within this system often occur in alkaline basins and swales and along the drawdown zones of lakes and ponds. .... **Inter-Mountain Basins Alkaline Closed Depression**

5b. Herbaceous wetlands not associated with alkaline to saline hardpan clay soils.................................**6**

6a. Wetlands with a permanent water source throughout all or most of the year. Water is at or above the surface throughout the growing season, except in drought years. This system can occur around ponds, as fringes around lakes and along slow-moving streams and rivers. If the wetland occurs within a mosaic of wetland or riparian systems, then the patch must be at least 0.1 hectares (0.25 acres). If the wetland occurs as an isolated patch surrounded by upland, then there is no minimum size criteria. The vegetation is dominated by common emergent and floating leaved species including species of *Scirpus*, *Schoenoplectus*, *Typha*, *Juncus*, *Carex*, *Potamogeton*, *Polygonum*, and *Nuphar* .... **Western North American Emergent Marsh**

6b. Herbaceous wetlands associated with a high water table or overland flow, but typically lacking standing water. Sites with *no channel formation* are typically associated with snowmelt and not subjected to high disturbance events such as flooding (Slope HGM Class). Sites *associated with a stream channel* are more tightly connected to overbank flooding from the stream channel than with snowmelt and groundwater discharge and may be subjected to high disturbance events such as flooding (Riverine HGM Class). Vegetation is dominated by herbaceous species; typically graminoids have the highest canopy cover including *Carex* spp., *Calamagrostis* spp., and *Deschampsia cespitosa* ....**Rocky Mountain Alpine-Montane Wet Meadow**

Appendix C. Level 1 Digital Data Set Sources and Scoring

Attribute	Metric	Data Source
	Distance to 4-wheel drive roads	ftp://ftp2.census.gov/geo/tiger/TIGER2009/
Roads	Distance to local roads	ftp://ftp2.census.gov/geo/tiger/TIGER2009/
	Distance to highways	ftp://ftp2.census.gov/geo/tiger/TIGER2009/
Hydrologic Disturbances	Distance to wells	http://nris.state.mt.us/nsdi/nhd/hiresgeo.asp
	Distance to canals or ditches	http://nris.state.mt.us/nsdi/nhd/hiresgeo.asp
	Percent of buffer in crop/agriculture	ftp://nris.mt.gov/MSDI_Landcover.zip
Land Cover/ Land Use Type	Percent of buffer in hay/pasture	ftp://nris.mt.gov/MSDI_Landcover.zip
	Percent of buffer in developed, open space	ftp://nris.mt.gov/MSDI_Landcover.zip
	Percent of buffer in low density residential	ftp://nris.mt.gov/MSDI_Landcover.zip
	Percent of buffer in medium density residential	ftp://nris.mt.gov/MSDI_Landcover.zip
Resource Use	Mines/ Gravel pits	http://nris.mt.gov/nsdi/orthophotos/raster_svc.asp
	Livestock Grazing	http://nris.mt.gov/nsdi/orthophotos/raster_svc.asp

Attribute	Metric	Distance in Meters					
		<100	100-200	200-300	300-500	500-1000	>1000
Roads	Distance to 4-wheel drive roads	3	2	1			
	Distance to local roads	4	3	2	1		
	Distance to highways	5	4	3	2	1	
Hydrologic Disturbances	Distance to wells	3	2	1			
	Distance to canals or ditches	3	2	1			
Resource Use	Mines/ Gravel pits	4		3		2	1
	Livestock Grazing	3	2	3			
		Percent of Buffer					
		<5%	5-15%	15-20%	20-40%	>40%	
Land Cover/ Land Use Type	Percent of buffer in crop/agriculture	1	2	3	4	5	
		<10%	10-25%	25-40%	>40%		
	Percent of buffer in hay/pasture	1	2	3	4		
	Percent of buffer in developed, open space	1	2	3	4		
	Percent of buffer in low density residential	1	2	3	4		
		<5%	5-15%	15-20%	20-30%	>30%	
	Percent of buffer in medium density residential	1	2	3	4	5	

Appendix D. Montana Natural Heritage Program Level 2 Ecological Integrity Assessment Form

ASSESSMENT AREA INFORMATION	
Site ID	Date
Site Name	Observer(s)
Level 4 Ecoregion	
Land Ownership	
HUC4/HUC5/HUC6	
GPS Coordinates at the assessment area center (UTMs)	Notes on movement of the AA center:
Waypoint ID	
Datum	
Easting (X)	
Northing (Y)	
Accuracy Elevation	
General AA description, including surrounding uplands	
Directions to AA and Access Comments:	

Soil Drainage (check one)		Topographic Position (check one)		Amount of AA Covered by Standing Water (check one)	
Well-drained		slope		none	
Mod well-drained		depression		1-25%	
Poorly drained		floodplain		26-50%	
Very poorly drained		flat		51-75%	
				76-100%	

Assessment Area Photos-Taken from the center of the AA in the four cardinal directions		
Photo #	Photo Card	Description
Photo #	N	
Photo #	E	
Photo #	S	
Photo #	W	
Additional Photos:		

CLASSIFICATION

Ecological System (check one--use Key to Ecological Systems)

____RM Fen
____RM Wet Meadow
____W. N. Am. Emergent Marsh
____RM Riparian Shrubland
____RM Riparian Woodland
____NRM Wooded Vernal Pool
____LM Riparian Woodland and Shrubland
____Other

Confidence Level

_____Very High
_____High
_____Medium
_____Low

Dominant Vegetation Association(s)

Reason for selecting confidence level:

HGM Class (check one)

_____Riverine
_____Depressional
_____Flat
_____Lacustrine Fringe
_____Slope

Confidence Level

_____Very High
_____High
_____Medium
_____Low

Reason for selecting confidence level:

Cowardin System

_____Palustrine (P)
_____Lacustrine Littoral (L2)
_____Riverine Lower Perennial (R2)
_____Riverine Upper Perennial (R3)

Cowardin Class

_____Aquatic Bed (AB)
_____Moss Lichen (ML)
_____Emergent (EM)
_____Forested (FO)
_____Scrub-Shrub (SS)
_____Unconsolidated Bottom (UB)
_____Unconsolidated Shore (US)

Cowardin Water Regime

_____Permanently Flooded (H)
_____Intermittently Exposed (G)
_____Semi-permanently Flooded (F)
_____Artificially Flooded (K)
_____Seasonally Flooded (C)
_____Saturated (B)
_____Temporarily Flooded (A)
_____Intermittently Flooded (J)

Cowardin Special Modifers

_____Beaver (b)
_____Excavated (x)
_____Partially ditched/drained (d)
_____Diked/impounded (h)
_____Farmed (f)

ASSESSMENT AREA DRAWING (add north arrow, document plant zones, indicate direction of drainage into or out of wetland, and include sketch of vegetation plot and soil pit placement). ALSO INDICATE ALL PLANT ZONES ON AERIAL PHOTO, IF POSSIBLE

Notes:

SOIL PROFILE DATA FORM

SiteID ______________

Soil Pit # __________ **GPS Waypoint Easting** ________________ (draw soil pit location on site drawing) **Northing** ____________ **Accuracy** ____________

Depth (cm)	Layer	Texture	Matrix Color* (Hue/Value/Chroma)	Redox Concentrations (Hue/Value/Chroma)	Redox Depletions (Hue/Value/Chroma)	Redox Concentration Abundance (%)	Redox Depletion Abundance (%)	**Hydric Soil Indicators Present? (Yes/No)	Depth to Saturation (cm)	Depth to free water in pit (cm) (NP=not present)

TOTAL PIT DEPTH (cm) ______

Hydric Soil Indicators (check all that apply):

- ______ Histosol (Organic layer greater than 20 cm)
- ______ Histic Epipedon (Organic layer at least 20 cm from surface)
- ______ Sulfidic (rotten eggs) odor
- ______ Organic streaking (dark vertical streaks in the subsurface layers)
- ______ Gleyed or Low Chroma Colors
- ______ Redox depletions-areas in soil that have lost iron; gray or reddish-gray in color
- ______ Redox concentrations-oxidation of iron; in patches, along root channels and in pores

Note: Redoximorphic features cannot form in soils with parent materials that are low in iron and manganese

Remarks:

*To determine the soil matrix color: if soils are dry, wet sample until it no longer changes color. Always have the sun at your back when comparing to color chart to find best match.

SOIL PROFILE DATA FORM

SiteID ____________

Soil Pit # ____________ **GPS Waypoint Easting** ____________ (draw soil pit location on site drawing) **Northing** ____________ **Accuracy** ____________

Depth (cm)	Layer	Texture	Matrix Color* (Hue/Value/Chroma)	Redox Concentrations (Hue/Value/Chroma)	Redox Depletions (Hue/Value/Chroma)	Redox Concentration Abundance (%)	Redox Depletion Abundance (%)	**Hydric Soil Indicators Present? (Yes/No)	Depth to Saturation (cm)	Depth to free water in pit (cm) (NP=not present)
TOTAL PIT DEPTH (cm)										

****Hydric Soil Indicators (check all that apply):**

____ Histosol (Organic layer greater than 20 cm)
____ Histic Epipedon (Organic layer at least 20 cm from surface)
____ Sulfidic (rotten eggs) odor
____ Organic streaking (dark vertical streaks in the subsurface layers)
____ Gleyed or Low Chroma Colors
____ Redox depletions-areas in soil that have lost iron; gray or reddish-gray in color
____ Redox concentrations-oxidation of iron; in patches, along root channels and in pores

Note: Redoximorphic features cannot form in soils with parent materials that are low in iron and manganese

Remarks:

*To determine the soil matrix color: if soils are dry, wet sample until it no longer changes color. Always have the sun at your back when comparing to color chart to find best match.

Plant Zones in Entire Assessment Area							
Height Scale for Each Plant Zone				Cover Scale for Each Plant Zone			
1	<0.5 m	6	10-15 m	1	Trace	6	10-<25%
2	0.5-1 m	7	15-20 m	2	<1%	7	25-<50%
3	1-2 m	8	20-35 m	3	1-<2%	8	50-<75%
4	2-5 m	9	35-50 m	4	2-<5%	9	75-<95%
5	5-10 m	10	>50 m	5	5-<10%	10	>95%

Identify and describe the plant zones that occur within the assessment area. A plant zone should be described if it meets the following rules: **1a**. The plant zone is dominated by a stratum distinctly different from the stratum that dominates other plant zones; OR **1b**. the plant zone is dominated by the same stratum as other plant zones, BUT each plant zone is dominated by different species AND the average height of the dominant species differs by > 1 m (e.g., *Typha latifolia* vs. *Juncus balticus*). **2**. The plant zone makes up more than 5% of the AA (e.g., 250 m^2 for an AA of 0.5 ha). **3**. Each individual patch of the plant zone is greater than $10m^2$.

Plant Zone #1 (indicate location on site drawing)

Stratum	Leaf Type (can check more than one)		
_____Forest/Woodland (Trees/Shrubs > 5 m)	_____Broad-leaved	_____Needle-leaved	
_____Shrubland (Shrubs >0.5-5 m)	_____Broad-leaved	_____Needle-leaved	_____Microphyllous
_____Dwarf Shrubland (<0.5 m)	_____Broad-leaved	_____Needle-leaved	_____Microphyllous
_____Herbaceous (e.g., Graminoids, Forbs, Ferns)	_____Graminoid	_____Forb	_____Fern
_____Nonvascular (Bryophytes, cryptogamic crusts)			
_____Submerged/Floating (Rooted or floating-exclude emergent)			
_____Sparsely Vegetated (including bare ground)			

Dominant Species	Height Class	Cover Class	Comments

Stratum #2 (indicate location on site drawing)

Stratum	Leaf Type (can check more than one)		
_____Forest/Woodland (Trees/Shrubs > 5 m)	_____Broad-leaved	_____Needle-leaved	
_____Shrubland (Shrubs >0.5-5 m)	_____Broad-leaved	_____Needle-leaved	_____Microphyllous
_____Dwarf Shrubland (<0.5 m)	_____Broad-leaved	_____Needle-leaved	_____Microphyllous
_____Herbaceous (e.g., Graminoids, Forbs, Ferns)	_____Graminoid	_____Forb	_____Fern
_____Nonvascular (Bryophytes, cryptogamic crusts)			
_____Submerged/Floating (Rooted or floating-exclude emergent)			
_____Sparsely Vegetated (including bare ground)			

Dominant Species	Height Class	Cover Class	Comments

Stratum #3 (indicate location on site drawing)

Stratum
______Forest/Woodland (Trees/Shrubs > 5 m)
______Shrubland (Shrubs >0.5-5 m)
______Dwarf Shrubland (<0.5 m)
______Herbaceous (e.g., Graminoids, Forbs, Ferns)
______Nonvascular (Bryophytes, cryptogamic crusts)
______Submerged/Floating (Rooted or floating-exclude emergent)
______Sparsely Vegetated (including bare ground)

Leaf Type (can check more than one)
______Broad-leaved ______Needle-leaved
______Broad-leaved ______Needle-leaved ______Microphyllous
______Broad-leaved ______Needle-leaved ______Microphyllous
______Graminoid ______Forb ______Fern

Dominant Species	Height Class	Cover Class	Comments

Stratum #4 (indicate location on site drawing)

Stratum
______Forest/Woodland (Trees/Shrubs > 5 m)
______Shrubland (Shrubs >0.5-5 m)
______Dwarf Shrubland (<0.5 m)
______Herbaceous (e.g., Graminoids, Forbs, Ferns)
______Nonvascular (Bryophytes, cryptogamic crusts)
______Submerged/Floating (Rooted or floating-exclude emergent)
______Sparsely Vegetated (including bare ground)

Leaf Type (can check more than one)
______Broad-leaved ______Needle-leaved
______Broad-leaved ______Needle-leaved ______Microphyllous
______Broad-leaved ______Needle-leaved ______Microphyllous
______Graminoid ______Forb ______Fern

Dominant Species	Height Class	Cover Class	Comments

Stratum #5 (indicate location on site drawing)

Stratum
______Forest/Woodland (Trees/Shrubs > 5 m)
______Shrubland (Shrubs >0.5-5 m)
______Dwarf Shrubland (<0.5 m)
______Herbaceous (e.g., Graminoids, Forbs, Ferns)
______Nonvascular (Bryophytes, cryptogamic crusts)
______Submerged/Floating (Rooted or floating-exclude emergent)
______Sparsely Vegetated (including bare ground)

Leaf Type (can check more than one)
______Broad-leaved ______Needle-leaved
______Broad-leaved ______Needle-leaved ______Microphyllous
______Broad-leaved ______Needle-leaved ______Microphyllous
______Graminoid ______Forb ______Fern

Dominant Species	Height Class	Cover Class	Comments

LANDSCAPE CONTEXT		
Connectivity		
Non-riverine	Select the statement that best describes the **landscape connectivity** within a 500 m buffer of the AA: **1**. Intact: AA embedded in 90-100% unfragmented, natural landscape. **2**. Variegated: AA embedded in 60-90% unfragmented, natural landscape. **3**. Fragmented: AA embedded in 20-60% unfragmented, natural landscape. **4**. Relictual: AA embedded in <20 % unfragmented, natural landscape.	
Riverine	Select the statement that best describes the **landscape connectivity** within 500 m upstream and downstream of the AA: **1**. Intact: AA embedded in 90-100% unfragmented, natural landscape. **2**. Variegated: AA embedded in 60 90% unfragmented, natural landscape. **3**. Fragmented: AA embedded in 20-60% unfragmented, natural landscape. **4**. Relictual: AA embedded in <20 % unfragmented, natural landscape.	
Buffer		
Length	Select the statement that best describes the **buffer length** of the AA: **1**. Buffer is 76-100% of the AA perimeter. **2**. Buffer is 51-75% of the AA perimeter. **3**. Buffer is 25-50% of the AA perimeter. **4**. Buffer is <25% of the AA perimeter, OR no buffer exists.	
Width	Select the statement that best describes the **buffer width** of the AA: **1**. Average buffer width between edge of the AA and the edge of the buffer is >200 m. **2**. Average buffer width between edge of AA and the edge of the buffer is >100-200 m. **3**. Average buffer width between edge of the AA and the edge of the buffer is 50-100 m. **4**. Average buffer width between edge of the AA and the edge of the buffer is <50 m, OR no buffer exists.	
Condition	Select the statement that best describes the **buffer condition** of the AA: **1**. Abundant (>95%) native vegetation cover, little or no (<5%) cover of non-native plants, intact soils, AND little or no trash. **2**. Substantial (>75–95%) native vegetation cover, low (5–25%) cover of non-native plants, intact or moderately disturbed soils, moderate or lesser amounts of trash, OR evidence of minor human visitation or recreation. **3**. Moderate (50-75%) native vegetation cover, moderate or extensive soil disturbance, moderate or greater amounts of trash, OR evidence of moderate human visitation or recreation. **4**. Low (<50%) cover of native vegetation, barren ground and highly disturbed soils, moderate or greater amounts of trash, evidence of high intensity human visitation or recreation, OR no buffer exists.	
Buffer Condition Comments	Describe elements that are NOT considered part of the buffer (e.g., roads, agriculture, etc.)	
SIZE		
Relative Patch Size	Select the statement that best describes the **relative patch size** of the entire wetland (current size of the wetland divided by the historic size of the wetland): **1**. Wetland is >95% of original size. **2**. Wetland is >80-95% of original size. **3**. Wetland is >50-80% of original size. **4**. Wetland is <50% of original size.	
Absolute Patch Size	Estimate the size of the entire wetland (from the aerial photo OR from the GIS). IF YOU ARE UNABLE TO ESTIMATE SIZE, PLEASE INDICATE ON THE FORM THAT THE SIZE SHOULD BE ESTIMATED IN THE OFFICE.	
VEGETATION STRUCTURE (BIOTA)		
Relative Cover of Native Plant Species	Select the statement that best describes the **relative cover of native plant species** within the AA: **1**. >99% of the vegetation cover within the AA is comprised of native vegetation. **2**. 95-99% of the vegetation cover within the AA is comprised of native vegetation. **3**. 80-94% of the vegetation cover within the AA is comprised of native vegetation. **4**. <80% of the vegetation cover within the AA is comprised of native vegetation. **5**. <50% of the vegetation cover within the AA is comprised of native vegetation.	
Invasive exotic species	Select the statement that best describes **invasive exotic species** within the AA: **1**. <1% of the vegetation cover within the AA is comprised of invasive exotic species. **2**. 1-3% of the vegetation cover within the AA is comprised of invasive exotic species. **3**. >3-5% of the vegetation cover within the AA is comprised of invasive exotic species. **4**. >5% of the vegetation cover within the AA is comprised of invasive exotic species.	
Invasive or highly tolerant natives	Select the statement that best describes the **invasive or highly tolerant natives** within the AA: **1**. <5% of the vegetation cover within the AA is comprised of invasive or tolerant native plant species. **2**. 5-10% of the vegetation cover within the AA is comprised of invasive or tolerant native plant species. **3**. >10-25% of the vegetation cover within the AA is comprised of invasive or tolerant native plant species. **4**. >25% of the vegetation cover within the AA is comprised of invasive or tolerant native plant species.	

Organic Matter Accumulation	Select the statement that best describes the **organic matter accumulation** of the site: **1.** Site has moderate amount of fine organic matter. New growth is more prevalent than previous years' growth. Layers of litter in pools or areas of topographic lows are thin. **2.** Site is characterized by small amounts of coarse organic debris, with little plant recruitment, OR debris is somewhat excessive. **3.** Site has little coarse debris and/or only scant fine debris OR debris is excessive.	
Physical Patch Types	How many **physical patch types** occur within the site (refer to physical patch type table)?	
Patch Interspersion	Select the statement that best describes the **patch interspersion** of the site: **1**. Horizontal structure consists of a very complex array of nested or interspersed irregular biotic/abiotic patches with no single dominant type. **2**. Horizontal structure consists of a moderately complex array of nested or interspersed irregular biotic/abiotic patches with no single dominant type. **3**.Horizontal structure consists of a simple array of nested or interspersed irregular biotic/abiotic patches with no single dominant type. **4**. Horizontal structure consists of one dominant patch type with no interspersion.	
PHYSICOCHEMICAL		
Soil Surface Integrity	Select the statement that describes the **soil surface integrity** of the site: **1**. Bare soil is limited to naturally caused disturbances such as flood deposition or game trails. **2**. Some bare soil due to human causes (including livestock) is present but the extent and impact is minimal. The depth of disturbance is limited to only a few inches and does not show evidence of ponding or channeling water. Any disturbance is likely to recover within a few years after the disturbance is removed. **3**. Bare soil due to human causes is common and will be slow to recover. There may be pugging due to livestock resulting in several inches of soil disturbance. ORVs or other machinery may have left some shallow ruts. Damage is not excessive and the site will recover with the removal of degrading human influences and moderate recovery times. **4**. Bare soil substantially degrades the site due to altered hydrology or other long-lasting impacts. Deep ruts from ORVs or machinery may be present, or livestock pugging and/or trails are widespread. Water, if present, would be channeled or ponded. The site will not recover without restoration and/or long recovery times.	
Water Quality	Select the statement that best describes the **water quality** of the site: **1.** No visual evidence of degraded water quality. Wetland species that respond to high nutrient levels are minimally present, if at all. Water is clear with no strong green tint or sheen. **2.** Some negative water quality indicators are present, but limited to small and localized areas within the wetland. Wetland species that respond to high nutrient levels may be present but are not dominant. Water may have a minimal greenish tint, cloudiness, or sheen. **3.** Negative water quality indicators or wetland species that respond to high nutrient levels are common. Sources of water quality degradation are apparent. Water may have a moderate greenish tint, sheen or other turbidity with algae common. **4.** Wetland is dominated by vegetation species that respond to high nutrient levels or there is widespread evidence of other negative water quality indicators. Algal mats may be extensive, blocking light to the bottom. Sources of water quality degradation are typically apparent. Water has strong greenish tint, sheen, or turbidity. The bottom difficult to see during the growing season.	
HYDROLOGY		
Water Source	Select the statement that best describes the **water source under dry season conditions of the AA**: **1.** Sources are precipitation, groundwater, and/or natural runoff, or natural flow from an adjacent freshwater body, or the AA naturally lacks water in the dry season. 2. Sources are mostly natural but can include occasional or small effects of modified hydrology (e.g., developed land or irrigated agricultural land comprising less than 20% of the drainage basin within 2 km of the AA, presence of a few small stormdrains or scattered homes with septic systems). No large point sources or dams control the overall hydrology. **3**. Sources or withdrawals are primarily from anthropogenic sources (e.g., urban runoff, direct irrigation, diversions, pumped water, impoundments, regulated releases through a dam, developed or irrigated agricultural land comprising more than 20% of the drainage basin within 2 km of the AA, presence of major drainage point source discharges that obviously control the hydrology of the AA). **4**. Natural sources have been eliminated based on the following indicators: impoundment of all wet season inflows, diversions of all dry-season inflows, predominance of xeric vegetation, etc.	
Hydroperiod (for depressional, lacustrine, and slope wetlands--NOT fens)	Which of the following statements best describes the **hydroperiod** of the site: **1**. Hydroperiod of the AA is characterized by natural patterns of filling or inundation and drying or drawdowns. **2**. The filling or inundation patterns in the AA are of greater magnitude or duration than would be expected under natural conditions, but thereafter the AA is subject to natural drawdown or drying. **3**. Hydroperiod of the AA is characterized by natural patterns of filling or inundation, but thereafter, is subject to more rapid or extreme drawdown or drying, as compared to more natural wetlands. OR The filling or inundation patterns in the AA are of substantially lower magnitude or duration than would be expected under natural conditions, but thereafter, the AA is subject to natural drawdown or drying. **4**. Both the inundation and drawdown of the AA deviate from natural conditions (either increased or decreased in magnitude and/or duration).	

Hydroperiod (for fens)	Select the statement that best describes the **hydroperiod** of the site: **1**. Hydroperiod of the site is characterized by stable, saturated hydrology, or by naturally damped cycles of saturation and partial drying. **2**. Hydroperiod of the site experiences minor altered inflows or drawdown/drying, as compared to more natural wetlands (e.g., ditching). **3**. Hydroperiod of the site is somewhat altered by greater increased inflow from runoff, or experiences moderate drawdown or drying, as compared to more natural wetlands (e.g., ditching). **4**. Hydroperiod of the site is greatly altered by increased inflow from runoff or experiences large drawdown or drying, as compared to more natural wetlands (e.g., ditching).	
Hydroperiod (for riverine sites)	Select the statement that best describes the **hydroperiod** of the site (based on field indicators in the worksheet): **1**. Most of the channel through the AA is characterized by equilibrium conditions, with little evidence of aggradation or degradation. **2**. Most of the channel through the AA is characterized by some aggradation or degradation, none of which is severe, and the channel seems to be approaching an equilibrium form. **3**. There is evidence of severe aggradation or degradation of most of the channel through the AA, or the channel is artificially hardened through less than half of the AA. **4**. The channel is concrete or otherwise artificially hardened through most of the AA.	
Groundwater Connectivity	Are there areas within the assessment area buffer that indicate groundwater connectivity (e.g., visually confirmed, temporary surface water connection to an upslope wetland; areas of vigorous growth of upland vegetation relative to the surrounding uplands).	
Hydrologic Connectivity (for depressional, lacustrine, and slope wetlands--NOT isolated fens)	Select the statement that best describes the **hydrologic connectivity** of the site: **1**. Rising water in the AA has unrestricted access to adjacent areas without levees or other obstructions to the lateral movement of flood waters. **2**. Unnatural features such as levees or road grades limit the amount of adjacent transition zone or the lateral movement of floodwaters, relative to what is expected for the setting, but the limitations exist for less than 50% of the AA perimeter. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. **3**. The amount of adjacent transition zone or the lateral movement of flood waters to and from the AA is limited, relative to what is expected for the setting, by unnatural features such as levees or road grades, for 50–90% of the AA perimeter. Flood flows may exceed the obstructions, but drainage out of the AA is probably obstructed. **4**. The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features such as levees or road grades, for more than 90% of the AA perimeter.	
Hydrologic Connectivity (for naturally isolated fens)	Select the statement that best describes the **hydrologic connectivity** of the site: **1**. No natural connectivity with the surrounding water bodies. **2**. Partial connectivity (e.g., ditching or draining to dry the fen). **3**. Substantial to full connectivity that has obvious effects of drying the peat body.	
Hydrologic Connectivity (for confined riverine wetlands)	Select the statement that best describes the **hydrologic connectivity** of the site based on the entrenchment ratio calculation: **1**. Entrenchment ratio >2.0. **2**. Entrenchment ratio 1.6-2.0. **3**. Entrenchment ratio 1.2-1.5. **4**. Entrenchment ratio <1.2.	
Hydrologic Connectivity (for unconfined riverine wetlands)	Select the statement that best describes the **hydrologic connectivity** of the site based on the entrenchment ratio calculation: **1**. Entrenchment ratio >2.2. **2**. Entrenchment ratio 1.9-2.2. **3**. Entrenchment ratio 1.5-1.8. **4**. Entrenchment ratio <1.5.	

PHYSICAL PATCH TYPE	CHECK ONE
Open water-pond or lake	
Open water -pools	
Open water-river/stream	
Open water-oxbow/backwater channel	
Open water-tributary/secondary channel	
Open water-beaver pond	
Deep emergent plants (> 0.5 m water depth)	
Shallow emergent plants (< 0.5 m water depth)	
Submerged/floating vegetation	
Active beaver dam	
Adjacent or onsite springs/seeps	
Shrubs/Trees	
Transitional meadow	
Saline meadow	
Debris jams/woody debris	
Pool/riffle complex	
Point bars	
Mudflats	
Wet meadow patches	
Plant hummocks/sediment mounds	
Water tracks/hollows	
Tall herbaceous vegetation (> 0.5 m tall)	
Low herbaceous vegetation (< 0.5 m tall)	
Floating mat	
Vegetation cover dominated by sedges/moss	
Number of observed patches	

Land Use Observed Within 500 m of the AA	Check all that apply
Paved roads / parking lots	
Domestic or commercially developed buildings	
Gravel pit operation, open pit mining, strip mining	
Unpaved Roads (e.g., driveway, tractor trail, 4-wheel drive roads)	
Mining (other than gravel, open pit, and strip mining), abandoned mines	
Resource extraction (oil and gas development)	
Agriculture - dryland farming	
Intensively managed golf courses, sports fields	
Vegetation conversion (chaining, cabling, rotochopping, clearcut)	
Heavy grazing by livestock	
Intense recreation (ATV use / camping / popular fishing spot, etc.)	
Logging or tree removal with 50-75% of trees >50 cm dbh removed	
Agriculture – irrigated cropland	
Agriculture – permanent tree plantation	
Dam sites and flood disturbed shorelines around water storage reservoirs	
Recent old fields and other disturbed fallow lands dominated by exotic species	
Moderate grazing on rangeland	
Moderate recreation (high-use trail)	
Selective logging or tree removal with <50% of trees >50 cm dbh removed	
Light grazing on rangeland	
Light recreation (low-use trail)	
Haying of native grassland	
Fallow with no history of grazing or other human use in past 10 yrs	
Natural area / land managed for native vegetation	
Land Use Observed Within the AA	
Vegetation conversion (chaining, cabling, rotochopping, clearcut)	
Heavy grazing by livestock	
Intense recreation (ATV use / camping / popular fishing spot, etc.)	
Logging or tree removal with 50-75% of trees >50 cm dbh removed	
Dam sites and flood disturbed shorelines around water storage reservoirs	
Recent old fields and other disturbed fallow lands dominated by exotic species	
Moderate grazing	
Moderate recreation (high-use trail)	
Selective logging or tree removal with <50% of trees >50 cm dbh removed	
Light grazing	
Light recreation (low-use trail)	
Natural area / land managed for native vegetation	
Hydrology Within 500 m of the AA	
Upstream spring boxes	
Impoundment	
Pumps, diversions, or ditches that move water out of the wetland	
Evidence of aquatic life mortality	
Encroachment of terrestrial vegetation	
Stress or mortality of hydrophytes	
Compressed or reduced plant zonation	
Berm	
Dike	
Pumps, diversions, or ditches that move water into the wetland	
Recently drowned riparian vegetation	
Extensive fine-grained deposits	

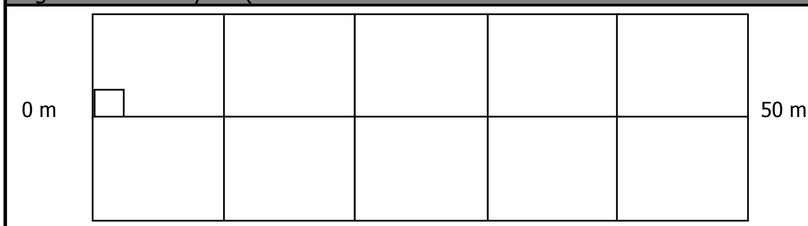
SiteID ________________

0 m
GPS Waypoint ________________ (draw vegetation plot location on site drawing)
Easting ________________ Northing ________________ Accuracy ________________

50 m
GPS Waypoint ________________ (draw vegetation plot location on site drawing)
Easting ________________ Northing ________________ Accuracy ________________

Vegetation Plot Photos	**Module**	**Bearing/Description**
Photo #		
Photo #		
Photo #		
Photo #		
Photo #		

Vegetation Plot Layout (circle the location of the intensive modules and note any changes to the plot layout)



Notes:

Plot Representativeness (discuss decisions for placement and/or whether the plot is representative of the assessment area)

Plant species presence and percent cover: For each intensive module, starting with the uppermost stratum, list all species in each stratum and estimate percent cover for the module. For tree species, estimate seedling, sapling, and mature trees separately. List any species found in the remaining modules in the residual “R” column and estimate percent cover for the entire plot. List any species outside the plot at the end of the table or designate with a 0 in Cover Class column. Mark location of the intensive modules on aerial photo for reference.

Cover Scale for Strata			
1	Trace	6	10-<25%
2	<1%	7	25-<50%
3	1-<2%	8	50-<75%
4	2-<5%	9	75-<95%
5	5-<10%	10	>95%

VEGETATION PLOT SPECIES TABLE									
		Module	**1**		**2**	**3**	**4**	**5**	**R**
		Cover Class	**Corner**	**Module**					
Stratum		**Species**							
Water									
Bare Ground									
Litter									
Bryophytes (all cover, including under vegetation or litter cover)									

APPENDIX E. CALCULATION OF LEVEL 2 ATTRIBUTE AND OVERALL AA SCORES

1. For each metric, convert narrative rating score (1, 2, 3, and 4) into the corresponding metric score: 1=12, 2=9, 3=6, and 4=3.

2. Each final attribute score was calculated according to the following:

   Landscape Context (LC) Attribute Score:

   Raw score = [Buffer Condition x (Buffer width x Buffer length)$^{1/2}$]$^{1/2}$ + Landscape Connectivity

   $$\text{Final Attribute score} = \frac{\text{Raw Landscape Context Score}}{\text{Total possible points allowed (24)}} \times 100$$

   Relative Patch Size Attribute Score:

   $$\text{Final Attribute score} = \frac{\text{Relative Patch Size Score}}{\text{Total possible points allowed (12)}} \times 100$$

   Biotic Attribute Score:

   $$\text{Raw score} = \frac{\text{(Invasive native + Native + Invasive scores)}}{3} + \text{OM accumulation} + \text{patch interspersion}$$

   $$\text{Final Attribute Score} = \frac{\text{Raw Biotic Score}}{\text{Total possible points allowed (36)}} \times 100$$

   Hydrology Attribute Score:

   Raw score = Hydrological Source + Hydroperiod + Hydrologic Connectivity scores

   $$\text{Final Attribute Score} = \frac{\text{Raw Hydrology Score}}{\text{Total possible points allowed (36)}} \times 100$$

   Physicochemical Attribute Score:

   Raw score = Soil Surface Integrity + Water Quality scores

   $$\text{Final Attribute Score} = \frac{\text{Raw Physicochemical Score}}{\text{Total possible points allowed (24)}} \times 100$$

3. $$\text{Final AA Score} = \frac{\text{Final LC + Final Patch Size + Final Biotic + Final Hydro +Final Physicochemical score}}{5}$$

Appendix F. Montana Natural Heritage Program Level 3 Intensive Vegetation Assessment Form

SiteID ________________

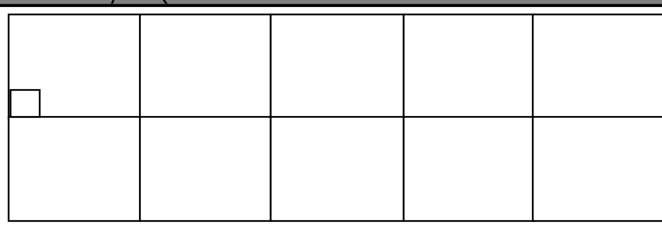
0 m
GPS Waypoint ________________ (draw vegetation plot location on site drawing)
Easting ________________ Northing ________________ Accuracy ________________

50 m
GPS Waypoint ________________ (draw vegetation plot location on site drawing)
Easting ________________ Northing ________________ Accuracy ________________

Vegetation Plot Photos	**Module**	**Bearing/Description**
Photo #		
Photo #		
Photo #		
Photo #		
Photo #		

Vegetation Plot Layout (circle the location of the intensive modules and note any changes to the plot layout)

0 m



50 m

Notes:

Plot Representativeness (discuss decisions for placement and/or whether the plot is representative of the assessment area)

Plant species presence and percent cover: For each intensive module, starting with the uppermost stratum, list all species in each stratum and estimate percent cover for the module. For tree species, estimate seedling, sapling, and mature trees separately. List any species found in the remaining modules in the residual “R” column and estimate percent cover for the entire plot. List any species outside the plot at the end of the table or designate with a 0 in Cover Class column. Mark location of the intensive modules on aerial photo for reference.

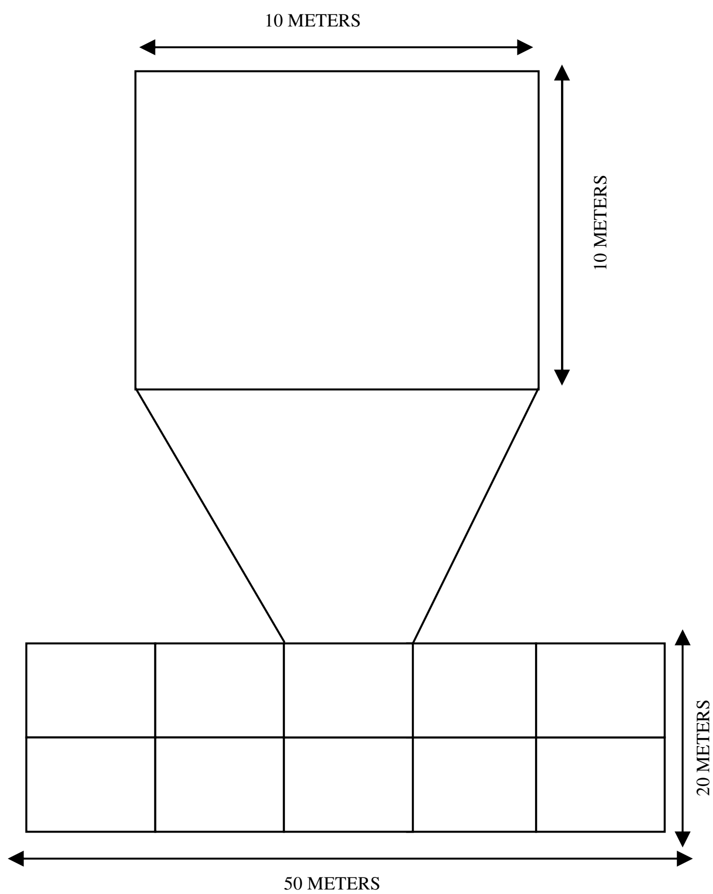
Cover Scale for Strata			
1	Trace	6	10-<25%
2	<1%	7	25-<50%
3	1-<2%	8	50-<75%
4	2-<5%	9	75-<95%
5	5-<10%	10	>95%

VEGETATION PLOT SPECIES TABLE									
		Module	**1**		**2**	**3**	**4**	**5**	**R**
		Cover Class	**Corner**	**Module**					
Stratum		**Species**							
Water									
Bare Ground									
Litter									
Bryophytes (all cover, including under vegetation or litter cover)									

Appendix G. Vegetation Cover Classes and Relevé Layout

The following cover classes were used to estimate vegetation cover:

1 = trace (one individual)	6 ≥ 10–25%
2 < 1%	7 ≥ 25–50%
3 ≥ 1–2%	8 ≥ 50–75%
4 ≥ 2–5%	9 ≥ 75–95%
5 ≥ 5–10%	10 ≥ 95%



Appendix H. Calculation and Description of Floristic Quality Assessment Indices

Indices	Formulas
Total species Richness	$N + A$
Native species richness	N
Non-native species richness	A
Mean C ($\overline{C}$ all)	$\overline{C} = \sum_{j=1}^{N+A} C_i \Big/ N + A$
Mean C of natives ($\overline{C}$ nat)	$\overline{C} = \sum_{j=1}^{N} C_i \Big/ N$
Cover-weighted Mean C (CW $\overline{C}$ all)	$\overline{C} = \sum_{j=1}^{N+A} p_i C_i \Big/ N + A$
Cover-weighted Mean C of natives (CW $\overline{C}$ nat)	$\overline{C} = \sum_{j=1}^{N} p_i C_i \Big/ N$
Floristic Quality Index for natives (FQI)	$FQI = \overline{C}\sqrt{N}$
Floristic Quality Index for all species (FQIall)	$FQIall = \overline{C}\sqrt{N + A}$
Cover-weighted FQI for natives (CWFQI)	$\mathrm{CWFQInat} = \left(\sum_{j=1}^{N} p_j C_j \right) \sqrt{N}$
Cover-weighted FQI for all species (CWFQIall)	$\mathrm{CWFQI} = \left(\sum_{j=1}^{N+A} p_j C_j \right) \sqrt{N + A}$
Adjusted FQI (AdjFQI)	$adjFQI = \left(\overline{C} \big/ 10 \right) \left(\sqrt{N} \big/ \sqrt{N + A} \right) * 100$
Adjusted cover-weighted FQI (adjCWFQI)	$adjCWFQI = \left(CW\overline{Cnat} \big/ 10 \right) \left(\sqrt{N} \big/ \sqrt{N + A} \right) * 100$

A Floristic Quality Index (FQI) was then calculated for each site assessed with a Level 3 using the following formula:

$$FQI = \overline{C}\sqrt{N}$$

Where $\overline{C}$ is the mean C-value and N is the number of native species within the entire plot.

A FQI including both native and non-native species was calculated using the following formula:

$$FQIall = \overline{C}\sqrt{N + A}$$

The adjusted FQI score for each site was calculated for each site using the following formula:

$$adjFQI = \left(\overline{C} / 10 \right) \left(\sqrt{N} / \sqrt{N + A} \right) * 100$$

where $\overline{C}$ is the mean C-value of native plant species, N is the number of native species, and A is the number of non-native species.

A cover-weighted index was calculated for each site using the following formula:

$$\text{Cover-weighted FQI} = \left(\sum_{j=1}^{N+A} p_j C_j \right) \sqrt{N + A}$$

Where p stands for the relative average cover of a species and C is the C-value of each species (j), N is the number of native species, and A is the number of non-native species.

A cover weighted adjusted FQI was also calculated for each site using the following formula:

$$\text{Adjusted cover-weighted FQI} = \left(CW\overline{Cnat} / 10 \right) \left(\sqrt{N} / \sqrt{N + A} \right) * 100$$

APPENDIX I. WETLAND LANDSCAPE PROFILING

5th Code HUC Wetland Profiles

Wetland Landscape Profiling of Palustrine Wetlands: Fifth-Code Hydrological Unit

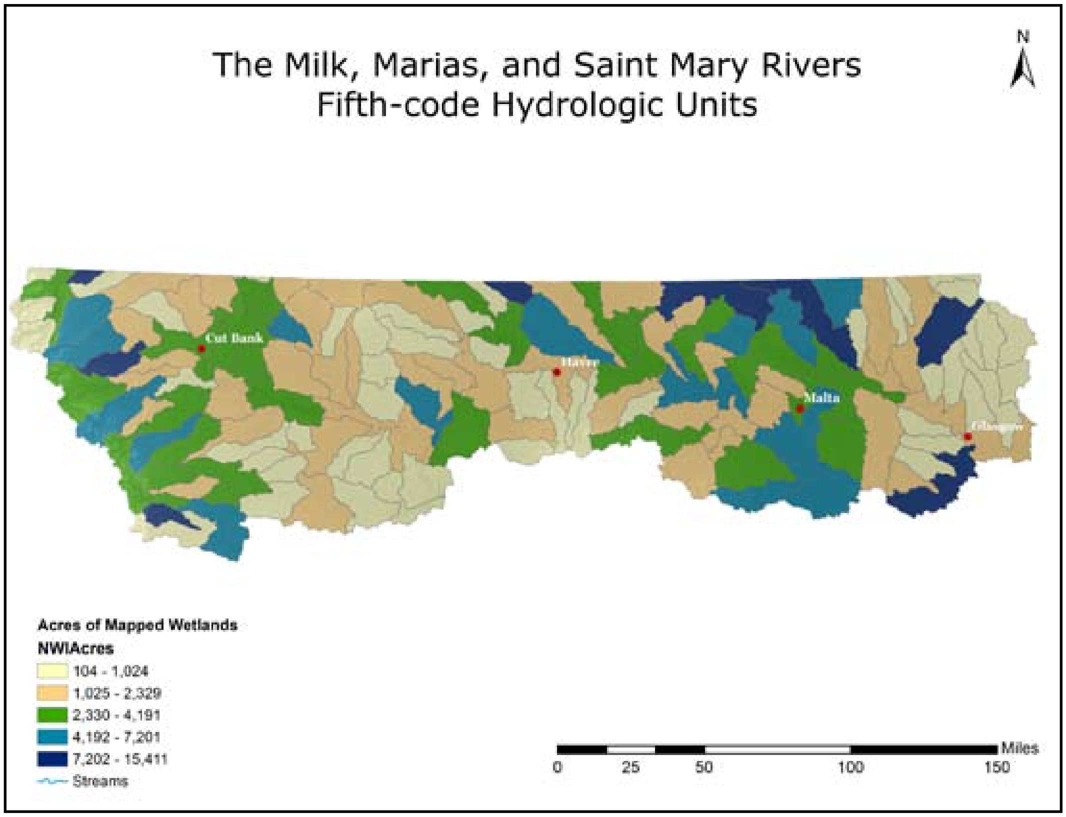
5th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Headwaters Saint Mary River	1001000201	0%	0%	100%	0%	100%	100%	0%
Swiftcurrent Creek	1001000202	0%	0%	60%	40%	100%	85%	15%
Upper Saint Mary River	1001000203	0%	0%	11%	89%	79%	99%	1%
Lee Creek	1001000204	0%	0%	4%	96%	85%	100%	0%
Willow Creek	1001000205	16%	1%	17%	67%	5%	85%	15%
Upper Two Medicine River	1003020101	0%	0%	28%	72%	87%	99%	1%
Badger Creek	1003020102	0%	0%	5%	95%	95%	99%	1%
Middle Two Medicine River	1003020103	0%	0%	0%	100%	82%	98%	2%
Blacktail Creek	1003020104	0%	0%	0%	100%	84%	96%	4%
Dupuyer Creek	1003020105	45%	0%	55%	0%	10%	98%	2%
Birch Creek	1003020106	40%	0%	10%	49%	68%	97%	3%
Lower Two Medicine River	1003020107	6%	0%	0%	94%	53%	88%	12%
Upper Cut Bank Creek	1003020201	0%	0%	3%	97%	86%	100%	0%
Willow Creek	1003020202	16%	1%	17%	67%	51%	85%	15%
Middle Cut Bank Creek	1003020203	0%	0%	0%	100%	64%	93%	7%
Little Rock Coulee	1003020204	0%	0%	0%	100%	70%	86%	14%
Big Rock Coulee	1003020205	52%	4%	0%	44%	25%	89%	11%
Spring Creek	1003020206	0%	0%	0%	100%	91%	90%	10%
Lower Cut Bank Creek	1003020207	25%	1%	0%	74%	71%	97%	3%
Marias River-Schultz Coulee	1003020301	100%	0%	0%	0%	9%	90%	10%
Sunburst	1003020302	96%	3%	1%	0%	49%	94%	6%
Rocky Spring Coulee	1003020303	94%	2%	5%	0%	100%	91%	9%
Spring Coulee	1003020304	99%	1%	0%	0%	1%	95%	5%
Aloe Lake	1003020305	97%	3%	0%	0%	100%	94%	6%
Upper Dry Fork Marias River	1003020306	64%	0%	36%	0%	13%	45%	55%
Lower Dry Fork Marias River	1003020307	98%	2%	0%	0%	5%	66%	34%
Marias River-Pearson Coulee	1003020308	88%	4%	8%	0%	12%	82%	18%
Upper Pondera Coulee	1003020309	99%	1%	0%	0%	2%	74%	26%
South Pondera Coulee	1003020310	96%	4%	0%	0%	12%	62%	38%
Rocky Coulee	1003020311	86%	14%	0%	0%	36%	82%	18%
Powder Coulee	1003020312	100%	0%	0%	0%	0%	71%	29%
Lower Pondera Coulee	1003020313	95%	5%	0%	0%	7%	66%	34%
Basin Coulee	1003020314	88%	12%	0%	0%	26%	33%	67%
Dugout Coulee	1003020315	91%	9%	0%	0%	9%	22%	78%
Upper Cottonwood Creek	1003020316	96%	4%	0%	0%	6%	80%	20%
Middle Cottonwood Creek	1003020317	92%	8%	0%	0%	9%	68%	32%
Lower Cottonwood Creek	1003020318	97%	3%	0%	0%	3%	64%	36%
East Fork Black Coulee	1003020319	98%	2%	0%	0%	2%	93%	7%
Black Coulee	1003020320	80%	7%	13%	0%	3%	85%	15%
Marias River-Dead Indian Coulee	1003020321	81%	2%	16%	0%	14%	54%	46%
Marias River-Chip Creek	1003020322	91%	9%	1%	0%	11%	50%	50%
Black Coulee	1003020401	80%	7%	13%	0%	5%	85%	15%
Trail Creek	1003020402	92%	6%	2%	0%	11%	69%	31%
Upper Willow Creek	1003020403	88%	11%	1%	0%	18%	76%	24%
West Fork Willow Creek	1003020404	97%	3%	0%	0%	7%	73%	27%
Eagle Creek	1003020405	82%	18%	0%	0%	22%	77%	23%
Lower Willow Creek	1003020406	91%	1%	8%	0%	3%	54%	46%
Teton River-North Fork Teton River	1003020501	60%	0%	40%	0%	86%	100%	0%
Willow Creek	1003020502	16%	1%	17%	67%	11%	85%	15%
Deep Creek	1003020503	53%	3%	44%	0%	13%	78%	22%

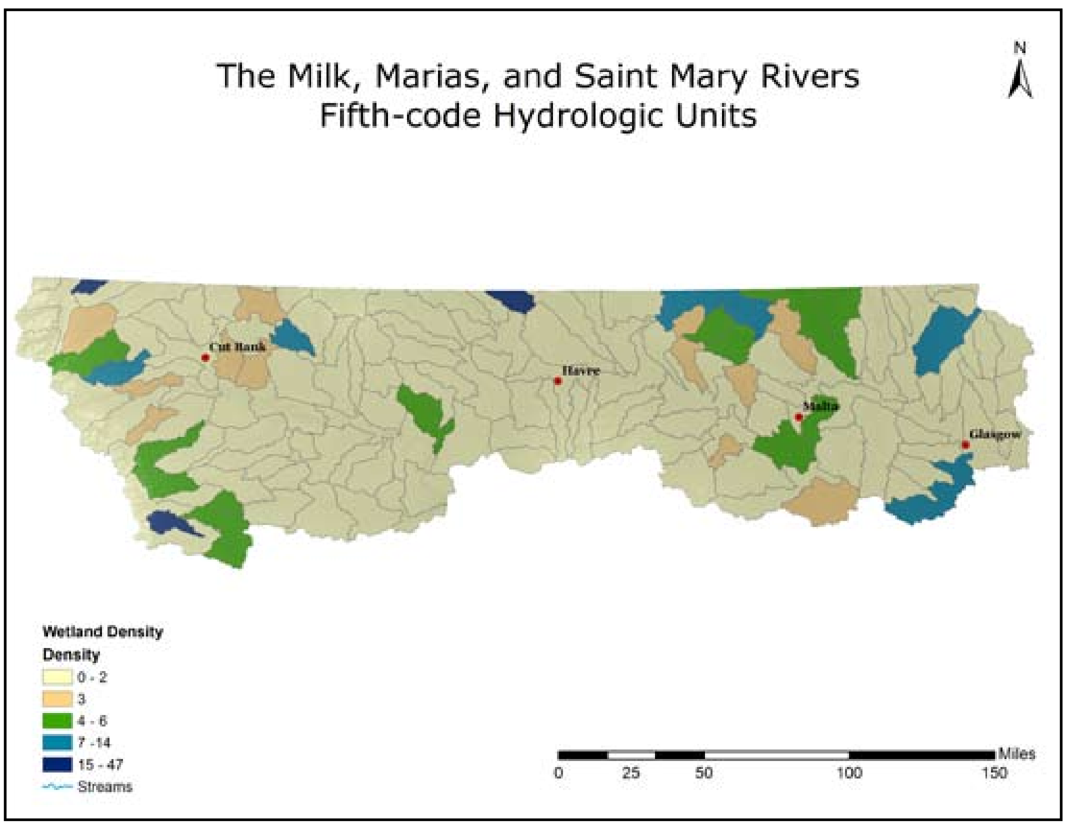
Wetland Landscape Profiling of Palustrine Wetlands: Fifth-Code Hydrological Unit

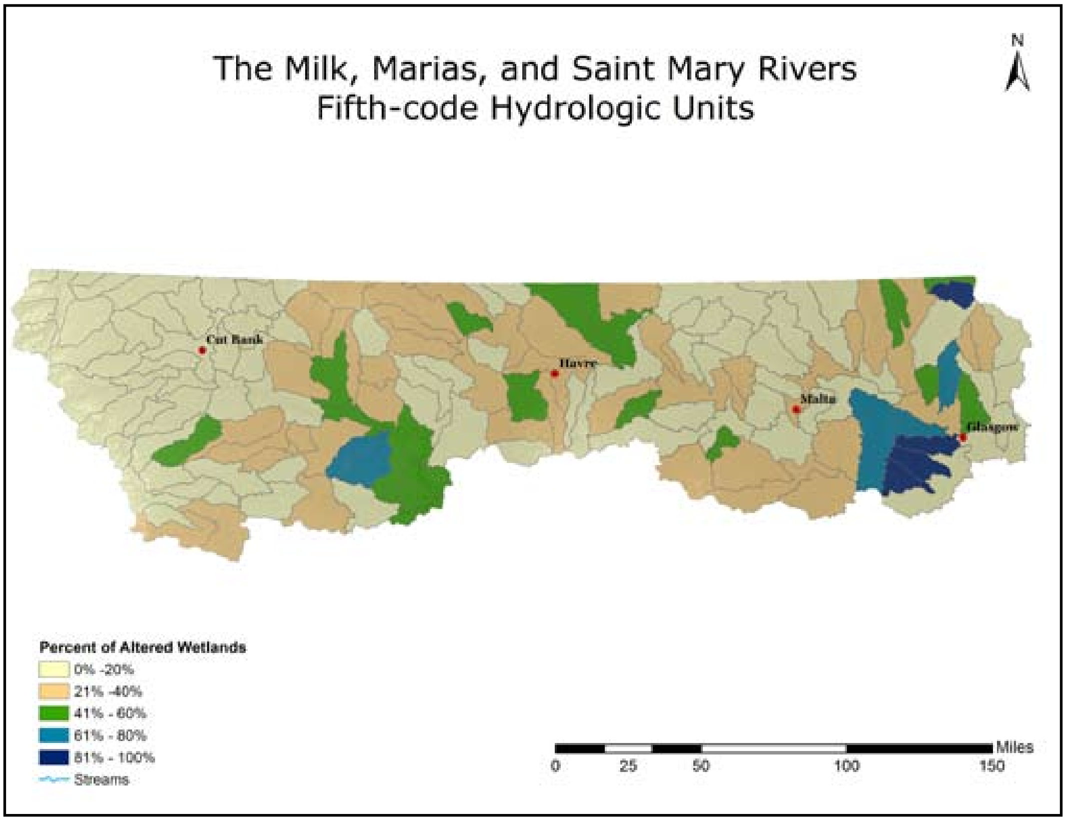
5th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Teton River-Choteau	1003020504	45%	52%	3%	0%	67%	66%	34%
Spring Coulee	1003020505	99%	1%	0%	0%	23%	95%	5%
Upper Muddy Creek	1003020506	66%	13%	21%	0%	41%	97%	3%
Middle Muddy Creek	1003020507	56%	0%	44%	0%	80%	97%	3%
Lower Muddy Creek	1003020508	92%	7%	1%	0%	23%	97%	3%
Teton River-Dutton	1003020509	89%	11%	0%	0%	12%	90%	10%
Teton River-Timber Coulee	1003020510	92%	7%	1%	0%	31%	79%	21%
Teton River-Weatherman Coulee	1003020511	95%	5%	0%	0%	17%	82%	18%
Teton River-Dry Fork Coulee	1003020512	91%	9%	0%	0%	11%	49%	51%
South Fork Milk River	1005000101	0%	0%	0%	100%	79%	99%	1%
North Fork Milk River	1005000102	0%	0%	0%	100%	41%	96%	4%
Milk River-Kennedy Coulee	1005000103	0%	0%	0%	100%	68%	93%	7%
Red River	1005000201	90%	9%	0%	0%	18%	87%	13%
Sweetgrass	1005000202	100%	0%	0%	0%	0%	89%	11%
Beaupre Coulee	1005000203	97%	2%	1%	0%	36%	87%	13%
Miners Coulee	1005000204	84%	4%	12%	0%	11%	78%	22%
Milk River-Spring Coulee	1005000205	49%	8%	43%	0%	88%	87%	13%
Ninemile Coulee	1005000206	66%	14%	21%	0%	52%	55%	45%
Dry Lake Coulee	1005000207	81%	5%	14%	0%	44%	93%	7%
Milk River-Fresno Reservoir	1005000208	36%	3%	61%	0%	88%	69%	31%
Wild Horse Lake	1005000301	99%	0%	0%	0%	100%	99%	1%
Beaver Creek	1005000401	81%	1%	0%	7%	46%	68%	32%
Little Boxelder Creek	1005000402	99%	1%	0%	0%	1%	83%	17%
Clear Creek	1005000403	97%	2%	1%	0%	9%	87%	13%
Milk River-Bullhook Creek	1005000404	74%	26%	0%	0%	38%	63%	37%
Redrock Coulee	1005000405	93%	4%	3%	0%	19%	78%	22%
Milk River-Fifteen Mile Creek	1005000406	85%	5%	10%	0%	22%	80%	20%
Box Elder Creek	1005000407	81%	19%	0%	0%	27%	59%	41%
Snake Creek	1005000408	96%	3%	1%	0%	6%	64%	36%
Thirtymile Creek	1005000409	72%	8%	20%	0%	46%	77%	23%
Wayne Creek	1005000410	86%	7%	7%	0%	34%	93%	7%
Savoy Creek	1005000411	81%	9%	10%	0%	35%	81%	19%
White Bear Creek	1005000412	13%	16%	0%	71%	93%	80%	20%
Milk River-Milk Creek	1005000413	55%	3%	3%	40%	79%	76%	24%
Dodson Creek	1005000414	72%	2%	26%	0%	46%	76%	24%
Milk River-Exeter Creek	1005000415	80%	3%	17%	0%	45%	84%	16%
Alkali Creek	1005000416	78%	6%	16%	0%	100%	81%	19%
Assiniboine Creek	1005000417	88%	6%	5%	0%	15%	82%	18%
Little Cottonwood Creek	1005000418	63%	7%	29%	2%	69%	89%	11%
Milk River-Hewitt Lake	1005000419	75%	3%	22%	1%	86%	76%	24%
Stinky Creek	1005000420	76%	8%	16%	0%	31%	62%	38%
Milk River-Snieder Coulee	1005000421	96%	3%	1%	0%	77%	94%	6%
Lonesome Lake	1005000501	98%	2%	0%	0%	46%	94%	6%
Big Sandy Creek-Gorman Creek	1005000502	80%	11%	0%	9%	28%	84%	16%
Big Sandy Creek-Boxelder Creek	1005000503	65%	7%	9%	18%	68%	73%	27%
Big Sandy Creek-Gravel Coulee	1005000504	75%	2%	0%	23%	30%	51%	49%
Upper Sage Creek	1005000601	94%	5%	0%	0%	12%	67%	33%
Little Sage Creek	1005000602	88%	12%	0%	0%	17%	78%	22%
O'Brien Coulee	1005000603	93%	7%	0%	0%	10%	73%	27%
England Coulee	1005000604	98%	2%	0%	0%	8%	92%	8%
Lower Sage Creek	1005000605	92%	8%	0%	0%	18%	63%	37%
Lodge Creek	1005000701	85%	8%	7%	0%	24%	56%	44%

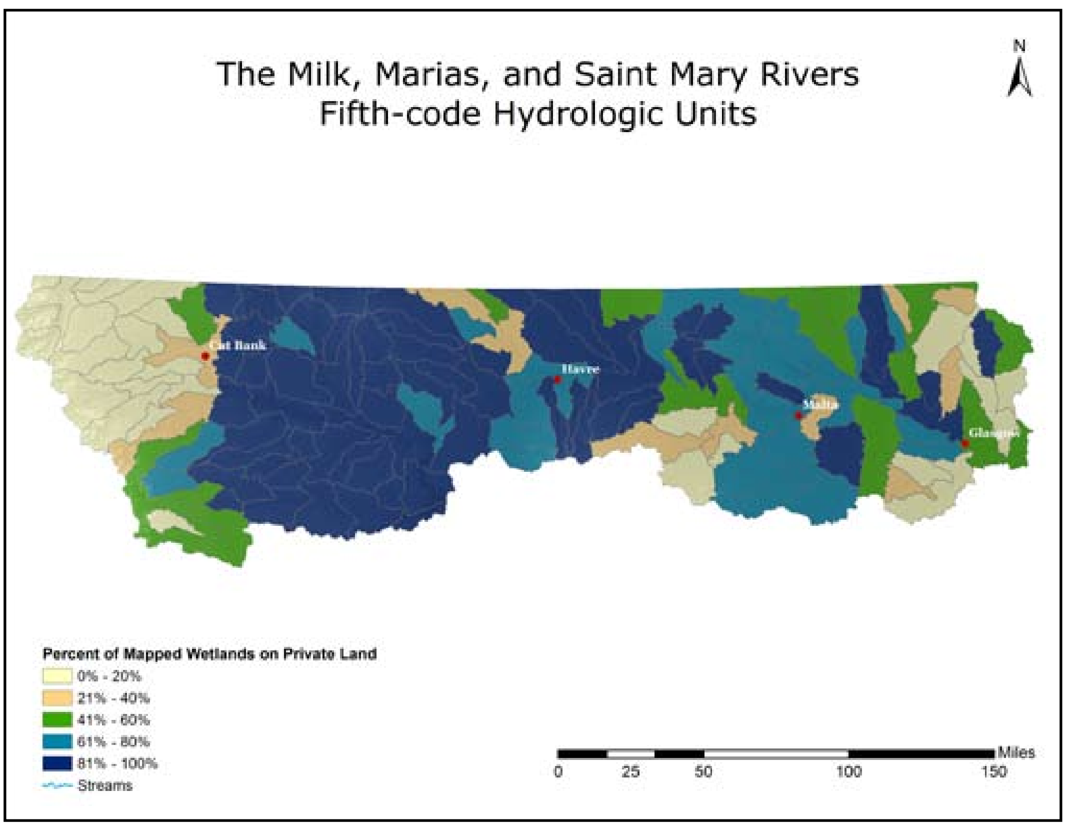
Wetland Landscape Profiling of Palustrine Wetlands: Fifth-Code Hydrological Unit

5th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
East Fork Battle Creek	1005000801	50%	18%	32%	0%	66%	62%	38%
Battle Creek	1005000802	81%	4%	15%	0%	100%	40%	60%
South Fork Peoples Creek	1005000901	10%	0%	0%	90%	97%	77%	23%
Upper Peoples Creek	1005000902	35%	20%	0%	45%	73%	81%	19%
Lone Tree Coulee	1005000903	7%	0%	0%	93%	92%	58%	42%
Lower Peoples Creek	1005000904	34%	0%	5%	61%	77%	83%	17%
Murray Coulee	1005001001	97%	3%	0%	0%	35%	99%	1%
Buckley Creek	1005001002	96%	4%	0%	0%	30%	100%	0%
Woody Island Coulee	1005001003	72%	3%	22%	2%	88%	98%	2%
Black Coulee	1005001004	80%	7%	13%	0%	26%	85%	15%
Cottonwood Creek	1005001005	65%	5%	29%	0%	43%	85%	15%
East Fork Whitewater Creek	1005001101	53%	7%	38%	1%	100%	92%	8%
Whitewater Creek	1005001102	59%	3%	38%	1%	92%	94%	6%
Bear Creek	1005001201	84%	2%	14%	0%	62%	54%	46%
Buggy Creek	1005001202	36%	26%	38%	0%	74%	38%	62%
Antelope Creek	1005001203	67%	5%	28%	0%	44%	21%	79%
Milk River-Hinsdale	1005001204	92%	5%	3%	0%	30%	79%	21%
Brazil Creek	1005001205	72%	2%	27%	0%	75%	3%	97%
Cherry Creek	1005001206	60%	30%	10%	0%	65%	59%	41%
Lone Tree Creek	1005001207	40%	1%	59%	0%	99%	3%	97%
Little Beaver Creek	1005001208	2%	3%	95%	0%	100%	2%	98%
Willow Creek	1005001209	16%	1%	17%	67%	11%	85%	15%
Milk River-Glasgow	1005001210	58%	1%	0%	41%	24%	92%	8%
Frenchman Creek	1005001301	82%	8%	9%	0%	27%	78%	22%
Big Warm Creek	1005001401	66%	4%	13%	17%	73%	65%	35%
Upper Beaver Creek	1005001402	65%	5%	29%	1%	44%	71%	29%
Flat Creek	1005001403	80%	1%	19%	0%	100%	73%	27%
Middle Beaver Creek	1005001404	83%	3%	14%	0%	56%	73%	27%
Lake Bowdion	1005001405	34%	2%	65%	0%	100%	94%	6%
Larb Creek	1005001406	60%	2%	38%	0%	50%	36%	64%
Lower Beaver Creek	1005001407	80%	3%	16%	0%	55%	91%	9%
Upper Rock Creek	1005001501	46%	0%	54%	0%	79%	49%	51%
South Creek	1005001502	33%	1%	66%	0%	100%	17%	83%
Crow Creek	1005001503	32%	8%	60%	0%	76%	43%	57%
Big Snake Creek	1005001504	70%	1%	28%	0%	36%	47%	53%
Willow Creek	1005001505	16%	1%	17%	67%	3%	85%	15%
Lower Rock Creek	1005001506	57%	4%	40%	0%	77%	61%	39%
Snow Coulee	1005001601	56%	1%	0%	44%	26%	87%	13%
Middle Fork Porcupine Creek	1005001602	82%	2%	1%	15%	14%	68%	32%
West Fork Porcupine Creek	1005001603	21%	32%	38%	9%	85%	75%	25%
East Fork Porcupine Creek	1005001604	0%	0%	0%	100%	27%	84%	16%
Porcupine Creek	1005001605	18%	28%	2%	52%	52%	87%	13%


The Milk, Marias, and Saint Mary Rivers
Fifth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Acres of Mapped Wetlands
NWIAcres
104 - 1,024
1,025 - 2,329
2,330 - 4,191
4,192 - 7,201
7,202 - 15,411
Streams
Miles
0 25 50 100 150


The Milk, Marias, and Saint Mary Rivers
Fifth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Wetland Density
Density
0 - 2
3
4 - 6
7 -14
15 - 47
Streams
Miles
0 25 50 100 150


The Milk, Marias, and Saint Mary Rivers
Fifth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Percent of Altered Wetlands
0% -20%
21% -40%
41% - 60%
61% - 80%
81% - 100%
Streams
Miles
0
25
50
100
150


The Milk, Marias, and Saint Mary Rivers
Fifth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Percent of Mapped Wetlands on Private Land
0% - 20%
21% - 40%
41% - 60%
61% - 80%
81% - 100%
Streams
Miles
0
25
50
100
150

6th Code HUC Wetland Profiles

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Headwaters Belly River	100100010201	0%	0%	0%	0%	0%	0%	0%
Upper Belly River	100100010203	0%	0%	0%	0%	100%	0%	0%
Headwaters Saint Mary River	100100020101	0%	0%	100%	0%	83%	100%	0%
Reynolds Creek	100100020102	0%	0%	100%	0%	73%	100%	0%
Red Eagle Creek	100100020103	0%	0%	100%	0%	55%	100%	0%
Saint Mary Lake	100100020104	0%	0%	100%	0%	41%	100%	0%
Swiftcurrent Lake	100100020201	0%	0%	100%	0%	0%	100%	0%
Boulder Creek	100100020202	0%	0%	58%	42%	52%	100%	0%
Swiftcurrent Creek	100100020203	0%	0%	54%	46%	74%	71%	29%
Duck Lake	100100020301	0%	0%	1%	99%	22%	100%	0%
Otatso Creek	100100020302	0%	0%	16%	84%	6%	100%	0%
Kennedy Creek	100100020303	0%	0%	37%	63%	8%	100%	0%
Lower Saint Mary Lakes	100100020304	0%	0%	5%	95%	100%	99%	1%
Saint Mary River-International Border	100100020305	0%	0%	14%	86%	16%	98%	2%
West Fork Lee Creek	100100020401	0%	0%	32%	68%	82%	100%	0%
East Fork Lee Creek	100100020402	0%	0%	0%	100%	100%	100%	0%
Upper Willow Creek	100100020501	0%	0%	1%	99%	0%	100%	0%
Upper Lake Creek	100301021101	0%	0%	0%	0%	84%	0%	0%
Lower Lake Creek	100301021102	0%	0%	0%	0%	0%	0%	0%
Benton Lake	100301021103	0%	0%	0%	0%	2%	0%	0%
Huntley Coulee	100301021403	0%	0%	0%	0%	95%	0%	0%
Missouri River-Black Coulee	100301021404	0%	0%	0%	0%	23%	0%	0%
Missouri River-Bullhead Coulee	100301021406	0%	0%	0%	0%	63%	0%	0%
Missouri River-Bird Coulee	100301021601	0%	0%	0%	0%	47%	0%	0%
Missouri River-Fort Benton	100301021602	0%	0%	0%	0%	42%	0%	0%
Missouri River-Rowe Bench	100301021605	0%	0%	0%	0%	49%	0%	0%
Headwaters North Fork Sun River	100301040103	0%	0%	0%	0%	39%	0%	0%
Route Creek	100301040104	0%	0%	0%	0%	56%	0%	0%
Upper North Fork Sun River	100301040107	0%	0%	0%	0%	2%	0%	0%
Biggs Creek	100301040108	0%	0%	0%	0%	65%	0%	0%
Middle North Fork Sun River	100301040110	0%	0%	0%	0%	98%	0%	0%
Beaver Creek	100301040403	0%	0%	0%	0%	5%	0%	0%
Sun River-Alkali Flat	100301040404	0%	0%	0%	0%	98%	0%	0%
Sun River-Split Rock Lake	100301040405	0%	0%	0%	0%	97%	0%	0%
Sun River-Pishkun Reservoir	100301040406	0%	0%	0%	0%	100%	0%	0%
Sun River-Shed Coulee	100301040601	0%	0%	0%	0%	4%	0%	0%
School Section Coulee	100301040701	0%	0%	0%	0%	42%	0%	0%
Upper Big Coulee	100301040705	0%	0%	0%	0%	37%	0%	0%
North Fork Muddy Creek	100301040801	0%	0%	0%	0%	11%	0%	0%
Muddy Creek Headwaters	100301040802	0%	0%	0%	0%	70%	0%	0%
Power	100301040803	0%	0%	0%	0%	8%	0%	0%
Upper Muddy Creek	100301040804	0%	0%	0%	0%	7%	0%	0%
Third Bench	100301040805	0%	0%	0%	0%	95%	0%	0%
Spring Coulee	100301040806	0%	0%	0%	0%	100%	0%	0%
Two Medicine Lake	100302010101	0%	0%	92%	8%	22%	92%	8%
Two Medicine River-Midvail Creek	100302010102	0%	0%	62%	38%	59%	98%	2%
Upper South Fork Two Medicine River	100302010103	0%	0%	100%	0%	7%	100%	0%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Lower South Fork Two Medicine River	100302010104	0%	0%	55%	45%	100%	100%	0%
Little Badger Creek	100302010105	0%	0%	2%	98%	100%	100%	0%
Two Medicine River-Elk Creek	100302010106	0%	0%	0%	100%	0%	99%	1%
Headwaters Badger Creek	100302010201	0%	0%	100%	0%	79%	100%	0%
Badger Creek-Lonesome Creek	100302010202	0%	0%	100%	0%	63%	100%	0%
Badger Creek-Mitten Lake	100302010203	0%	0%	0%	100%	43%	98%	2%
Badger Creek-Hay Coulee	100302010204	0%	0%	0%	100%	15%	99%	1%
Whitetail Creek	100302010205	0%	0%	0%	100%	11%	100%	0%
Lower Badger Creek	100302010206	0%	0%	0%	100%	52%	99%	1%
Two Medicine River-Big Nose Coulee	100302010301	0%	0%	0%	100%	50%	99%	1%
Two Medicine River-Hagan Flat	100302010302	0%	0%	0%	100%	49%	97%	3%
Upper Blacktail Creek	100302010401	0%	0%	0%	100%	47%	99%	1%
Lower Blacktail Creek	100302010402	0%	0%	0%	100%	11%	88%	12%
Upper Dupuyer Creek	100302010501	50%	0%	50%	0%	6%	99%	1%
Sheep Creek	100302010502	28%	0%	72%	0%	10%	99%	1%
Middle Dupuyer Creek	100302010503	33%	0%	67%	0%	100%	97%	3%
Lower Dupuyer Creek	100302010504	98%	2%	0%	0%	46%	96%	4%
Middle Fork Birch Creek	100302010601	0%	0%	100%	0%	6%	100%	0%
South Fork Birch Creek	100302010602	0%	0%	100%	0%	95%	100%	0%
North Fork Birch Creek	100302010603	0%	0%	100%	0%	100%	100%	0%
Upper Birch Creek	100302010604	8%	0%	50%	43%	100%	99%	1%
Cartwright Coulee	100302010605	97%	3%	0%	0%	100%	90%	10%
Middle Birch Creek	100302010606	49%	0%	1%	50%	100%	99%	1%
Rocky Ridge Coulee	100302010607	0%	0%	0%	100%	0%	96%	4%
Lower Birch Creek	100302010608	59%	0%	0%	41%	18%	97%	3%
Kipps Coulee	100302010701	0%	0%	0%	100%	45%	62%	38%
Two Medicine River-Shields Crossing	100302010702	6%	0%	0%	94%	45%	90%	10%
North Fork Cut Bank Creek	100302020101	0%	0%	22%	78%	0%	100%	0%
Upper Cut Bank Creek-Running Crane Lake	100302020102	0%	0%	1%	99%	66%	100%	0%
Greasewood Creek	100302020103	0%	0%	0%	100%	96%	99%	1%
Upper Cut Bank Creek-Sharp Lake	100302020104	0%	0%	0%	100%	41%	99%	1%
Depot Creek	100302020201	0%	0%	23%	77%	9%	88%	12%
Upper Willow Creek	100302020202	0%	0%	0%	100%	29%	99%	1%
Middle Willow Creek	100302020203	0%	0%	0%	100%	0%	99%	1%
Lower Willow Creek	100302020204	0%	0%	0%	100%	2%	99%	1%
Trail Coulee	100302020301	0%	0%	0%	100%	1%	50%	50%
Cut Bank John Coulee	100302020302	0%	0%	0%	100%	0%	69%	31%
Cobell Coulee	100302020303	0%	0%	0%	100%	7%	48%	52%
Powell Coulee	100302020304	0%	0%	0%	100%	0%	77%	23%
Middle Cut Bank Creek-Ford	100302020305	0%	0%	0%	100%	24%	99%	1%
Upper Little Rock Coulee	100302020401	0%	0%	0%	100%	36%	82%	18%
Middle Little Rock Coulee	100302020402	0%	0%	0%	100%	100%	76%	24%
South Fork Little Rock Coulee	100302020403	0%	0%	0%	100%	0%	93%	7%
Lower Little Rock Coulee	100302020404	0%	0%	0%	100%	0%	68%	32%
East Fork Big Rock Coulee	100302020501	46%	2%	0%	52%	60%	83%	17%
Headwaters Big Rock Coulee	100302020502	0%	0%	0%	100%	29%	77%	23%
Upper Big Rock Coulee	100302020503	5%	0%	0%	95%	0%	84%	16%
Middle Big Rock Coulee	100302020504	89%	10%	0%	1%	41%	99%	1%

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6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Lower Big Rock Coulee	100302020505	40%	0%	0%	60%	8%	80%	20%
Guardipee Lake	100302020601	0%	0%	0%	100%	80%	97%	3%
Mission Lake	100302020602	0%	0%	0%	100%	14%	58%	42%
Upper Spring Creek	100302020603	0%	0%	0%	100%	7%	99%	1%
Lower Spring Creek	100302020604	0%	0%	0%	100%	80%	97%	3%
Gillam Coulee	100302020701	0%	0%	0%	100%	54%	61%	39%
Cut Bank Creek-Wasteway Coulee	100302020702	0%	0%	0%	100%	17%	99%	1%
Snake Coulee	100302020703	98%	2%	0%	0%	55%	100%	0%
Old Maids Coulee	100302020704	97%	3%	0%	0%	100%	83%	17%
Cut Bank Creek-Hope Lake	100302020705	6%	0%	0%	94%	49%	90%	10%
Cut Bank Creek	100302020706	32%	1%	0%	67%	27%	80%	20%
Marias River-Appott Coulee	100302030101	100%	0%	0%	0%	73%	97%	3%
Bullhead Creek	100302030102	100%	0%	0%	0%	76%	95%	5%
Schultz Coulee	100302030103	99%	1%	0%	0%	5%	85%	15%
Marias River-Interfluvial	100302030104	99%	1%	0%	0%	56%	78%	22%
East Fork Red River	100302030201	98%	2%	0%	0%	10%	77%	23%
Rim Rock Colony	100302030202	91%	8%	0%	0%	53%	93%	7%
Gravel Pit	100302030203	100%	0%	0%	0%	63%	93%	7%
Sunburst	100302030204	99%	0%	1%	0%	7%	95%	5%
Willshaw Flats	100302030205	96%	3%	1%	0%	0%	96%	4%
Kevin	100302030301	91%	4%	5%	0%	100%	92%	8%
Healy Coulee	100302030302	99%	1%	0%	0%	2%	89%	11%
Upper Rocky Spring Coulee	100302030303	94%	1%	5%	0%	68%	71%	29%
Lower Rocky Spring Coulee	100302030304	96%	0%	4%	0%	0%	93%	7%
Sand Coulee	100302030401	98%	2%	0%	0%	100%	81%	19%
Upper Spring Coulee	100302030402	98%	2%	0%	0%	5%	93%	7%
Lower Spring Coulee	100302030403	94%	6%	0%	0%	68%	87%	13%
Aloe Lake	100302030501	95%	5%	0%	0%	100%	94%	6%
Mead Coulee	100302030502	99%	1%	0%	0%	49%	95%	5%
South Fork Dry Fork Marias River	100302030601	72%	0%	28%	0%	100%	23%	77%
Middle Fork Dry Fork Marias River	100302030602	7%	0%	93%	0%	100%	94%	6%
Lake Frances	100302030603	97%	3%	0%	0%	64%	77%	23%
North Fork Dry Fork Marias River	100302030604	99%	1%	0%	0%	72%	70%	30%
Lone Man Coulee	100302030605	100%	0%	0%	0%	100%	9%	91%
Dry Fork Marias River-New Miami Colony	100302030606	76%	24%	0%	0%	0%	35%	65%
Spring Creek	100302030701	97%	3%	0%	0%	31%	71%	29%
Dry Fork Marias River-Williams	100302030702	100%	0%	0%	0%	54%	70%	30%
Big Flat Coulee	100302030703	93%	7%	0%	0%	23%	82%	18%
Little Flat Coulee	100302030704	100%	0%	0%	0%	16%	64%	36%
Dry Fork Marias River-Latz Lake	100302030705	100%	0%	0%	0%	25%	59%	41%
Dry Fork Marias River-Fowler	100302030706	98%	2%	0%	0%	20%	61%	39%
Pearson Coulee	100302030801	97%	3%	0%	0%	18%	87%	13%
Marias River-Shelby	100302030802	97%	0%	2%	0%	6%	70%	30%
Marias River-Williamson Park	100302030803	94%	6%	0%	0%	21%	86%	14%
Marias River-F Bridge	100302030804	77%	4%	19%	0%	99%	74%	26%
Marias River-Hoffman Coulee	100302030805	90%	5%	5%	0%	1%	90%	10%
Upper Upper Pondera Coulee	100302030901	99%	1%	0%	0%	3%	79%	21%
Middle Upper Pondera Coulee	100302030902	98%	2%	0%	0%	10%	70%	30%
Favot Coulee	100302030903	99%	1%	0%	0%	100%	69%	31%
Lower Upper Pondera Coulee	100302030904	99%	1%	0%	0%	15%	75%	25%
Upper South Pondera Coulee	100302031001	94%	6%	0%	0%	0%	69%	31%

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6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Lower South Pondera Coulee	100302031002	99%	1%	0%	0%	0%	50%	50%
Upper Rocky Coulee	100302031101	99%	1%	0%	0%	29%	61%	39%
Lower Rocky Coulee	100302031102	80%	20%	0%	0%	5%	92%	8%
Upper Powder River	100302031201	100%	0%	0%	0%	4%	70%	30%
Lower Powder River	100302031202	100%	0%	0%	0%	15%	75%	25%
Flat Coulee	100302031301	96%	4%	0%	0%	7%	47%	53%
Dead Indian Coulee	100302031302	98%	2%	0%	0%	100%	46%	54%
Upper Lower Pondera Coulee	100302031303	83%	17%	0%	0%	27%	74%	26%
Middle Lower Pondera Coulee	100302031304	99%	1%	0%	0%	68%	87%	13%
Timber Coulee	100302031305	100%	0%	0%	0%	100%	81%	19%
Lower Lower Pondera Coulee	100302031306	81%	19%	0%	0%	10%	16%	84%
Upper Basin Coulee	100302031401	86%	14%	0%	0%	20%	38%	62%
Middle Basin Coulee	100302031402	97%	3%	0%	0%	16%	43%	57%
Lower Basin Coulee	100302031403	77%	23%	0%	0%	13%	11%	89%
North Fork Dugout Coulee	100302031501	99%	1%	0%	0%	7%	15%	85%
Upper Dugout Coulee	100302031502	95%	5%	0%	0%	13%	38%	62%
East Fork Dugout Coulee	100302031503	89%	11%	0%	0%	0%	14%	86%
Lower Dugout Coulee	100302031504	81%	19%	0%	0%	1%	11%	89%
Corral Creek	100302031601	100%	0%	0%	0%	31%	86%	14%
Government Creek	100302031602	88%	12%	0%	0%	12%	87%	13%
Horse Creek	100302031603	96%	4%	0%	0%	100%	72%	28%
Upper Cottonwood Creek	100302031604	99%	1%	0%	0%	44%	77%	23%
Cottonwood Creek	100302031701	95%	5%	0%	0%	21%	65%	35%
Tiber Coulee	100302031702	86%	14%	0%	0%	15%	73%	27%
Cottonwood Creek-Chester	100302031703	96%	4%	0%	0%	76%	65%	35%
Cox Coulee	100302031801	96%	4%	0%	0%	59%	53%	47%
Twelvemile Coulee	100302031802	100%	0%	0%	0%	49%	29%	71%
Sixmile Coulee	100302031803	98%	2%	0%	0%	88%	87%	13%
Cottonwood Creek-Larson Coulee	100302031804	94%	6%	0%	0%	40%	26%	74%
Headwaters East Fork Black Coulee	100302031901	98%	2%	0%	0%	9%	96%	4%
East Fork Black Coulee-Joplin	100302031902	100%	0%	0%	0%	27%	96%	4%
East Fork Black Coulee-Inverness	100302031903	94%	6%	0%	0%	50%	82%	18%
100302031904	100302031904	100%	0%	0%	0%	35%	98%	2%
East Fork Black Coulee-Ean School	100302031905	100%	0%	0%	0%	67%	90%	10%
Lower East Fork Black Coulee	100302031906	99%	1%	0%	0%	76%	66%	34%
Headwaters Black Coulee	100302032001	85%	15%	0%	0%	56%	93%	7%
Upper Black Coulee	100302032002	99%	1%	0%	0%	47%	47%	53%
Rocky Coulee	100302032003	100%	0%	0%	0%	7%	67%	33%
Middle Black Coulee	100302032004	97%	3%	0%	0%	40%	41%	59%
Flat Coulee	100302032005	96%	4%	0%	0%	27%	47%	53%
Lower Black Coulee	100302032006	95%	5%	0%	0%	0%	93%	7%
Marias River-Bootlegger Trail	100302032101	92%	1%	7%	0%	26%	74%	26%
Marias River-Smith Coulee	100302032102	15%	2%	83%	0%	11%	16%	84%
Marias River-Spring Coulee	100302032103	50%	3%	47%	0%	14%	90%	10%
Hay Coulee	100302032104	91%	0%	8%	0%	37%	47%	53%
Marias River-Horse Coulee	100302032105	87%	10%	3%	0%	24%	44%	56%
Dead Indian Coulee	100302032106	99%	1%	0%	0%	28%	36%	64%
Marias River-Eightmile Coulee	100302032107	100%	0%	0%	0%	46%	68%	32%
Marias River-Fourmile Coulee	100302032108	97%	1%	2%	0%	8%	5%	95%
Sheep Coulee	100302032201	100%	0%	0%	0%	80%	14%	86%
Lone Tree Coulee	100302032202	91%	9%	0%	0%	19%	0%	100%
Dry Fork Coulee West	100302032203	89%	11%	0%	0%	37%	72%	28%

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6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Chip Creek	100302032204	96%	3%	1%	0%	100%	65%	35%
Dry Fork Coulee East	100302032205	81%	19%	0%	0%	100%	12%	88%
Marias River-Loma	100302032206	93%	4%	3%	0%	9%	67%	33%
Fifteenmile Coulee	100302040101	84%	15%	1%	0%	88%	89%	11%
Black Coulee	100302040102	92%	8%	0%	0%	34%	63%	37%
Upper Trail Creek	100302040201	93%	5%	2%	0%	100%	72%	28%
Lower Trail Creek	100302040202	90%	10%	0%	0%	0%	55%	45%
Upper Miners Coulee	100302040301	94%	1%	4%	0%	25%	81%	19%
Lower Miners Coulee	100302040302	84%	16%	0%	0%	20%	78%	22%
Upper-Upper Willow Creek	100302040303	92%	8%	0%	0%	25%	78%	22%
Middle-Upper Willow Creek	100302040304	91%	9%	0%	0%	16%	69%	31%
Sheep Creek	100302040305	82%	18%	0%	0%	100%	69%	31%
Lower-Upper Willow Creek	100302040306	67%	33%	0%	0%	86%	73%	27%
Upper Dunkirk Coulee	100302040401	100%	0%	0%	0%	100%	46%	54%
Lower Dunkirk Coulee	100302040402	100%	0%	0%	0%	0%	86%	14%
Upper West Fork Willow Creek	100302040403	94%	6%	0%	0%	3%	76%	24%
Antelope Coulee	100302040404	96%	4%	0%	0%	8%	65%	35%
Crooked Coulee	100302040405	91%	9%	0%	0%	33%	75%	25%
Lower West Fork Willow Creek	100302040406	98%	2%	0%	0%	80%	63%	37%
Upper Eagle Creek	100302040501	79%	21%	0%	0%	3%	78%	22%
Lower Eagle Creek	100302040502	84%	16%	0%	0%	44%	76%	24%
Upper-Lower Willow Creek	100302040601	99%	1%	0%	0%	34%	31%	69%
Kinyon Coulee	100302040602	98%	2%	0%	0%	54%	62%	38%
Middle-Lower Willow Creek	100302040603	98%	2%	0%	0%	100%	37%	63%
Lower-Lower Willow Creek	100302040604	71%	1%	28%	0%	19%	52%	48%
Upper North Fork Teton River	100302050101	0%	0%	100%	0%	8%	100%	0%
Lower North Fork Teton River	100302050102	0%	0%	100%	0%	21%	99%	1%
South Fork Teton River	100302050103	0%	0%	100%	0%	83%	100%	0%
Middle Fork Teton River	100302050104	2%	0%	98%	0%	78%	99%	1%
Teton River-McDonald Creek	100302050105	61%	0%	39%	0%	6%	100%	0%
South Fork Willow Creek	100302050201	0%	0%	100%	0%	64%	95%	5%
North Fork Willow Creek	100302050202	86%	0%	14%	0%	60%	100%	0%
Upper Willow Creek	100302050203	0%	0%	100%	0%	42%	96%	4%
Lower Willow Creek	100302050204	3%	0%	97%	0%	23%	89%	11%
Upper Deep Creek	100302050301	0%	0%	100%	0%	100%	81%	19%
Hay Coulee	100302050302	49%	0%	51%	0%	100%	63%	37%
Nunemaker Coulee	100302050303	81%	18%	1%	0%	36%	68%	32%
Dog Creek	100302050304	51%	1%	48%	0%	2%	51%	49%
Middle Deep Creek	100302050305	44%	1%	54%	0%	46%	84%	16%
Lower Deep Creek	100302050306	98%	2%	0%	0%	18%	92%	8%
Teton River-Hod Main Coulee	100302050401	84%	14%	2%	0%	46%	87%	13%
Upper Freezeout Lake	100302050402	22%	75%	3%	0%	19%	63%	37%
Roundup Coulee	100302050403	74%	26%	0%	0%	62%	54%	46%
Lower Freezeout Lake	100302050404	23%	73%	4%	0%	79%	45%	55%
Teton River-Spring Coulee	100302050405	74%	26%	0%	0%	92%	100%	0%
Teton River-Gamble Coulee	100302050406	100%	0%	0%	0%	83%	91%	9%
Upper Spring Coulee	100302050501	100%	0%	0%	0%	29%	99%	1%
Lower Spring Coulee	100302050502	100%	0%	0%	0%	66%	90%	10%
Muddy Creek-Rinker Creek	100302050601	11%	42%	47%	0%	83%	69%	31%
Blindhorse Creek	100302050602	48%	48%	4%	0%	17%	95%	5%
Blackleaf Creek	100302050603	72%	0%	27%	0%	14%	98%	2%
Muddy Creek-Miller Creek	100302050604	78%	0%	22%	0%	37%	94%	6%

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6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Muddy Creek-Bynum	100302050701	25%	0%	75%	0%	6%	91%	9%
Muddy Creek-Foster Creek	100302050702	65%	0%	35%	0%	100%	98%	2%
Jones Creek	100302050801	99%	1%	0%	0%	38%	95%	5%
Farmer Coulee	100302050802	97%	2%	0%	0%	100%	86%	14%
Kropp Coulee	100302050803	91%	9%	0%	0%	9%	97%	3%
Muddy Creek-Eyraud Lakes	100302050804	85%	11%	3%	0%	24%	100%	0%
Muddy Creek	100302050805	96%	4%	0%	0%	80%	95%	5%
Teton River-Alkali Flat	100302050901	100%	0%	0%	0%	26%	97%	3%
Teton River-Collins	100302050902	100%	0%	0%	0%	51%	80%	20%
Old Railroad Coulee	100302050903	100%	0%	0%	0%	91%	69%	31%
Upper Muddy Creek	100302050904	99%	1%	0%	0%	49%	57%	43%
Kerr Bridge	100302050905	77%	23%	0%	0%	33%	99%	1%
Kinnerely Coulee	100302051001	95%	1%	4%	0%	36%	88%	12%
Flat Coulee	100302051002	99%	1%	0%	0%	9%	68%	32%
Teton River-Rye Coulee	100302051003	81%	19%	0%	0%	20%	95%	5%
East Fork Timber Coulee	100302051004	89%	11%	0%	0%	8%	45%	55%
Timber Coulee	100302051005	100%	0%	0%	0%	91%	42%	58%
Berry Coulee	100302051006	95%	5%	0%	0%	25%	82%	18%
Teton River-Sheep Coulee	100302051007	99%	1%	0%	0%	100%	68%	32%
East-West Knee	100302051101	96%	4%	0%	0%	63%	80%	20%
Teton River-100302051102	100302051102	97%	3%	0%	0%	50%	13%	87%
Teton River-Dent Bridge	100302051103	72%	28%	0%	0%	84%	78%	22%
Antelope Coulee	100302051104	98%	2%	0%	0%	3%	96%	4%
Weatherman Coulee	100302051105	97%	3%	0%	0%	24%	78%	22%
Teton River-Frank Gilbert	100302051106	100%	0%	0%	0%	91%	88%	12%
Chimney Rock Coulee	100302051201	94%	6%	0%	0%	69%	47%	53%
West Fork Dry Coulee	100302051202	100%	0%	0%	0%	10%	8%	92%
Dry Fork Coulee	100302051203	98%	2%	0%	0%	0%	14%	86%
Teton River-Eightmile Coulee	100302051204	92%	8%	0%	0%	12%	78%	22%
Teton River-Collins School	100302051205	46%	52%	3%	0%	48%	87%	13%
Lower Little Sandy Creek	100401010101	0%	0%	0%	0%	100%	0%	0%
Upper Little Sandy Creek	100401010102	100%	0%	0%	0%	49%	100%	0%
Little Eagle Creek	100401010201	0%	0%	0%	0%	28%	0%	0%
Missouri River-Archers Island	100401010302	0%	0%	0%	0%	4%	0%	0%
Six Mile Coulee	100401010303	0%	0%	0%	0%	19%	0%	0%
Spring Coulee	100401010304	0%	0%	0%	0%	30%	0%	0%
Coal Banks Coulee	100401010305	0%	0%	0%	0%	58%	0%	0%
Upper Birch Creek	100401010801	0%	0%	0%	0%	10%	0%	0%
Upper Suction Creek	100401040101	0%	0%	0%	0%	69%	0%	0%
Upper Little Suction Creek	100401040103	0%	0%	0%	0%	46%	0%	0%
Lower Little Suction Creek	100401040104	0%	0%	0%	0%	11%	0%	0%
Lower Suction Creek	100401040105	0%	0%	0%	0%	78%	0%	0%
North Fork of Cow Creek	100401040201	0%	0%	0%	0%	21%	0%	0%
South Fork of Cow Creek	100401040202	0%	0%	0%	0%	30%	0%	0%
Gap Creek	100401040203	0%	0%	0%	0%	4%	0%	0%
Upper Cow Creek	100401040205	0%	0%	0%	0%	98%	0%	0%
Squaw Creek	100401040207	0%	0%	0%	0%	49%	0%	0%
Upper Rock Creek	100401040602	0%	0%	0%	0%	74%	0%	0%
Bull Creek	100401040701	0%	0%	0%	0%	6%	0%	0%
Upper CK Creek	100401040801	0%	0%	0%	0%	37%	0%	0%
Upper Beauchamp Creek	100401040901	0%	0%	0%	0%	9%	0%	0%
Dry Fork Creek	100401040903	0%	0%	0%	0%	23%	0%	0%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Tank Coulee	100401041201	0%	0%	0%	0%	35%	0%	0%
Second Creek	100401041202	0%	0%	0%	0%	0%	0%	0%
Upper Telegraph Creek	100401041204	0%	0%	0%	0%	98%	0%	0%
Lone Tree Coulee	100401041501	0%	0%	0%	0%	35%	0%	0%
Square Creek	100401041502	0%	0%	0%	0%	22%	0%	0%
Shotgun Coulee	100401041503	0%	0%	0%	0%	78%	0%	0%
Upper Timber Creek	100401041504	0%	0%	0%	0%	29%	0%	0%
Plum Coulee	100401041505	0%	0%	0%	0%	18%	0%	0%
Upper Sutherland Creek	100401041901	0%	0%	0%	0%	43%	0%	0%
Lower Sutherland Creek	100401041903	0%	0%	0%	0%	29%	0%	0%
Duck Creek	100401042005	0%	0%	0%	0%	0%	0%	0%
Upper Eighth Coulee	100401042006	0%	0%	0%	0%	40%	0%	0%
Middle Eighth Coulee	100401042007	0%	0%	0%	0%	31%	0%	0%
Seventh Coulee	100401042701	0%	0%	0%	0%	94%	0%	0%
Sixth Coulee	100401042703	0%	0%	0%	0%	0%	0%	0%
Fifth Coulee	100401042704	0%	0%	0%	0%	0%	0%	0%
South Fork Duck Creek	100401042707	0%	0%	0%	0%	24%	0%	0%
Missouri River-North Fork Duck Creek	100401042709	0%	0%	0%	0%	82%	0%	0%
Upper South Fork Milk River	100500010101	0%	0%	0%	100%	84%	100%	0%
Middle South Fork Milk River	100500010102	0%	0%	0%	100%	96%	100%	0%
Livermore Creek	100500010103	0%	0%	0%	100%	3%	98%	2%
Upper Middle Fork Milk River	100500010104	0%	0%	0%	100%	89%	97%	3%
Lower Middle Fork Milk River	100500010105	0%	0%	0%	100%	5%	97%	3%
Lower South Fork Milk River	100500010106	0%	0%	0%	100%	2%	95%	5%
Upper North Fork Milk River	100500010201	0%	0%	0%	100%	89%	99%	1%
Middle North Fork Milk River	100500010202	0%	0%	0%	100%	100%	78%	22%
Lower North Fork Milk River	100500010203	0%	0%	0%	100%	18%	98%	2%
Milk River-Red Buttes	100500010301	0%	0%	0%	100%	97%	28%	72%
Milk River-Kennedy Coulee	100500010302	0%	0%	0%	100%	15%	93%	7%
Milk River-Coal Bank Coulee	100500010303	0%	0%	0%	100%	100%	95%	5%
Milk River-Antelope Spring	100500010304	0%	0%	0%	100%	63%	94%	6%
Oil Field	100500020101	89%	11%	0%	0%	7%	93%	7%
Fitzpatrick Coulee	100500020102	93%	7%	0%	0%	100%	80%	20%
Rim Rock Colony	100500020103	85%	15%	0%	0%	59%	86%	14%
Red River	100500020104	93%	7%	0%	0%	49%	87%	13%
Sweetgrass	100500020200	100%	0%	0%	0%	38%	89%	11%
Beaupre Coulee	100500020301	97%	2%	1%	0%	4%	89%	11%
Police Creek	100500020302	98%	2%	0%	0%	0%	63%	37%
Upper Miners Coulee	100500020401	84%	4%	13%	0%	96%	82%	18%
Breed Creek	100500020402	79%	2%	19%	0%	1%	80%	20%
Police Creek	100500020403	78%	22%	0%	0%	43%	86%	14%
Bear Gulch	100500020404	97%	3%	0%	0%	51%	74%	26%
Lower Miners Coulee	100500020405	87%	1%	12%	0%	18%	70%	30%
Upper Spring Coulee	100500020501	93%	7%	0%	0%	2%	61%	39%
Lower Springe Coulee	100500020502	32%	8%	60%	0%	7%	97%	3%
Upper Ninemile Coulee	100500020601	90%	10%	0%	0%	86%	35%	65%
Middle Ninemile Coulee	100500020602	68%	31%	1%	0%	90%	55%	45%
Lower Ninemile Coulee	100500020603	22%	0%	78%	0%	95%	90%	10%
Dry Lake Coulee	100500020701	79%	9%	12%	0%	17%	98%	2%
Upper Chain of Lakes Coulee	100500020702	82%	2%	16%	0%	66%	90%	10%
Milk River-Kennedy Coulee	100500020801	95%	5%	0%	0%	1%	87%	13%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Milk RIver-Lost River	100500020802	94%	6%	0%	0%	20%	73%	27%
Milk River-Spring Coulee	100500020803	27%	3%	71%	0%	10%	98%	2%
100500020804	100500020804	90%	10%	0%	0%	0%	63%	37%
100500020805	100500020805	90%	9%	1%	0%	100%	74%	26%
Archie Coulee	100500020806	47%	2%	51%	0%	40%	65%	35%
Milk River-Upper Fresno Reservoir	100500020807	7%	1%	92%	0%	15%	64%	36%
Cottonwood Coulee	100500020808	86%	4%	10%	0%	65%	70%	30%
Milk River-Lower Fresno Reservoir	100500020809	72%	5%	24%	0%	100%	61%	39%
Wild Horse Lake	100500030100	99%	0%	0%	0%	5%	99%	1%
Upper Beaver Creek	100500040101	43%	0%	0%	41%	8%	85%	15%
Middle Beaver Creek	100500040102	53%	2%	0%	0%	62%	76%	24%
Lower Beaver Creek	100500040103	96%	1%	0%	0%	5%	62%	38%
Upper Little Boxelder Creek	100500040201	100%	0%	0%	0%	33%	97%	3%
Lower Little Boxelder Creek	100500040202	98%	2%	0%	0%	43%	74%	26%
Upper Clear Creek	100500040301	98%	2%	0%	0%	1%	93%	7%
Middle Clear Creek	100500040302	100%	0%	0%	0%	26%	83%	17%
Lower Clear Creek	100500040303	95%	3%	2%	0%	57%	87%	13%
Fresno Coulee	100500040401	99%	1%	0%	0%	6%	43%	57%
Milk River-Nelson Coulee	100500040402	86%	14%	0%	0%	77%	30%	70%
Bullhook Creek	100500040403	99%	1%	0%	0%	15%	55%	45%
Milk River-Havre	100500040404	57%	43%	0%	0%	8%	73%	27%
Milk River-Davey Coulee	100500040405	74%	26%	0%	0%	52%	75%	25%
Dog Coulee	100500040501	95%	5%	0%	0%	29%	74%	26%
Staton Coulee	100500040502	94%	6%	0%	0%	6%	65%	35%
Lohman Coulee	100500040503	97%	1%	1%	0%	1%	91%	9%
Upper Redrock Coulee	100500040504	88%	12%	0%	0%	8%	56%	44%
Coal Coulee	100500040505	79%	21%	0%	0%	38%	48%	52%
Middle Redrock Coulee	100500040506	93%	1%	5%	0%	0%	87%	13%
Lower Redrock Coulee	100500040507	75%	1%	25%	0%	0%	63%	37%
Black Coulee	100500040601	95%	5%	0%	0%	0%	60%	40%
Lone Tree Coulee	100500040602	100%	0%	0%	0%	86%	48%	52%
Milk River-Sixteen Mile Creek	100500040603	98%	2%	0%	0%	0%	87%	13%
Fifteen Mile Creek	100500040604	68%	8%	24%	0%	0%	66%	34%
Milk River-Harlem Canal	100500040605	90%	4%	6%	0%	11%	92%	8%
Little Box Elder Coulee	100500040701	45%	55%	0%	0%	40%	73%	27%
Upper Box Elder Creek	100500040702	91%	9%	0%	0%	71%	55%	45%
Lower Box Elder Creek	100500040703	98%	2%	0%	0%	2%	52%	48%
Upper Snake Creek	100500040801	95%	5%	0%	0%	92%	64%	36%
Middle Snake Creek	100500040802	93%	4%	3%	0%	0%	49%	51%
Bean Creek	100500040803	97%	3%	0%	0%	22%	72%	28%
Lower Snake Creek	100500040804	97%	3%	0%	0%	95%	61%	39%
Northwest Fork Thirtymile Creek	100500040901	83%	5%	11%	1%	8%	70%	30%
Upper Thirtymile Creek	100500040902	75%	2%	23%	0%	15%	79%	21%
East Branch Thirtymile Creek	100500040903	73%	11%	15%	1%	4%	74%	26%
Lower Thirtymile Creek	100500040904	59%	14%	27%	0%	5%	80%	20%
West Fork Wayne Creek	100500041001	88%	0%	12%	0%	0%	78%	22%
East Fork Wayne Creek	100500041002	93%	3%	4%	0%	78%	97%	3%
Wayne Creek	100500041003	69%	19%	12%	0%	0%	88%	12%
Black Creek	100500041101	82%	5%	13%	0%	18%	78%	22%
Upper Savoy Creek	100500041102	78%	19%	2%	0%	73%	75%	25%
Lower Savoy Creek	100500041103	84%	0%	16%	0%	0%	93%	7%
Upper White Bear Creek	100500041201	28%	39%	0%	33%	45%	77%	23%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Upper Fifteen Mile Creek	100500041202	16%	14%	0%	70%	8%	83%	17%
Lower Fifteen Mile Creek	100500041203	0%	0%	0%	100%	96%	91%	9%
Lower White Bear Creek	100500041204	0%	0%	0%	100%	33%	58%	42%
Forgey Creek	100500041301	74%	10%	16%	0%	95%	52%	48%
Milk River-Harlem	100500041302	45%	0%	0%	54%	51%	92%	8%
Threemile Creek	100500041303	6%	0%	0%	94%	24%	61%	39%
Milk River -Threemile Reservoir	100500041304	58%	1%	1%	40%	90%	95%	5%
Milk Creek	100500041305	78%	11%	10%	0%	0%	74%	26%
Milk River-Milk Creek	100500041306	52%	1%	1%	46%	1%	52%	48%
100500041401	100500041401	59%	1%	39%	0%	0%	69%	31%
Upper Dodson Creek	100500041402	83%	3%	14%	0%	39%	88%	12%
Lower Dodson CreeK	100500041403	96%	2%	1%	0%	100%	75%	25%
Spring Coulee	100500041501	99%	0%	1%	0%	0%	88%	12%
Milk River-Cow Creek	100500041502	92%	0%	8%	0%	7%	73%	27%
Davison Coulee	100500041503	91%	4%	5%	0%	0%	86%	14%
Exeter Creek	100500041504	88%	7%	4%	0%	0%	73%	27%
Milk River-Dodson North Canal	100500041505	66%	4%	30%	0%	0%	88%	12%
Upper Alkali Creek	100500041601	75%	5%	20%	0%	26%	86%	14%
West Alkali Creek	100500041602	74%	2%	24%	0%	30%	67%	33%
Halfway Coulee	100500041603	80%	0%	20%	0%	0%	59%	41%
Middle Alkali Creek	100500041604	84%	13%	3%	0%	85%	81%	19%
Lower Alkali Creek	100500041605	77%	2%	21%	0%	57%	86%	14%
Upper Assiniboine Creek	100500041701	93%	6%	1%	0%	0%	82%	18%
Middle Assiniboine Creek	100500041702	86%	7%	7%	0%	0%	85%	15%
Lower Assiniboine Creek	100500041703	62%	5%	33%	0%	26%	65%	35%
Martin Lake	100500041801	58%	7%	33%	1%	79%	90%	10%
100500041802	100500041802	90%	8%	0%	2%	0%	66%	34%
Austin Coulee	100500041803	88%	4%	2%	6%	10%	87%	13%
Little Cottonwood Creek	100500041804	86%	2%	10%	2%	100%	83%	17%
Milk River-Malta	100500041901	90%	2%	7%	1%	0%	80%	20%
Milk River-Horse Camp Coulee	100500041902	51%	1%	48%	0%	7%	92%	8%
Martins Coulee	100500041903	51%	7%	34%	8%	51%	66%	34%
Milk River-Little Cottonwood Creek	100500041904	94%	0%	6%	0%	49%	97%	3%
Milk River-Hewitt Lake	100500041905	77%	4%	19%	0%	96%	59%	41%
Upper Stinky Creek	100500042001	70%	16%	15%	0%	80%	58%	42%
Eask Fork Stinky Creek	100500042002	77%	1%	22%	0%	28%	62%	38%
Lower Stinky Creek	100500042003	87%	11%	2%	0%	50%	74%	26%
Milk River-Dry Stinky Creek	100500042101	92%	7%	1%	0%	13%	91%	9%
Milk River-Snieder Coulee	100500042102	98%	1%	1%	0%	11%	95%	5%
Twelvemile Coulee	100500050101	100%	0%	0%	0%	92%	64%	36%
Upper Sixmile Coulee	100500050102	93%	7%	0%	0%	44%	63%	37%
Lower Sixmile Coulee	100500050103	93%	7%	0%	0%	78%	97%	3%
Fourteenmile Coulee	100500050104	96%	4%	0%	0%	9%	95%	5%
Twelvemile Coulee	100500050105	97%	3%	0%	0%	36%	90%	10%
Lonesome Lake	100500050106	99%	0%	1%	0%	3%	96%	4%
Muddy Creek	100500050201	0%	0%	0%	100%	13%	96%	4%
Big Sandy Creek-Godfrey Creek	100500050202	85%	6%	0%	9%	17%	88%	12%
Big Sandy Creek-Rattlesnake Butte	100500050203	84%	16%	0%	0%	5%	83%	17%
Gorman Creek	100500050204	88%	3%	0%	9%	78%	79%	21%
Big Sandy Creek-Lonesome Lake Coulee	100500050301	47%	22%	31%	0%	5%	75%	25%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Duck Creek	100500050302	66%	1%	0%	34%	1%	30%	70%
Boxelder Creek	100500050303	20%	0%	0%	80%	41%	86%	14%
Big Sandy Creek-Barneys Coulee	100500050304	97%	2%	0%	1%	19%	75%	25%
Big Sandy Creek-Schwartz Creek	100500050401	52%	1%	0%	47%	12%	34%	66%
Gravel Coulee	100500050402	23%	1%	0%	76%	10%	29%	71%
Spring Coulee	100500050403	99%	0%	0%	1%	80%	33%	67%
Sprinkle Coulee	100500050404	89%	11%	0%	0%	97%	58%	42%
Big Sandy Creek-Antelope Coulee	100500050405	99%	1%	0%	0%	55%	71%	29%
Laird Creek	100500060101	91%	7%	2%	0%	2%	68%	32%
Headwaters of Sage Creek	100500060102	94%	6%	0%	0%	21%	83%	17%
Sage Creek-Lost Coulee	100500060103	90%	10%	0%	0%	92%	70%	30%
Sage Creek-Immanuel Church	100500060104	94%	6%	0%	0%	1%	56%	44%
Sage Creek-Strode	100500060105	94%	6%	0%	0%	0%	38%	62%
Laird Lake	100500060106	98%	2%	0%	0%	100%	68%	32%
Rudyard Road	100500060107	99%	1%	0%	0%	3%	60%	40%
Oreana School	100500060108	100%	0%	0%	0%	11%	83%	17%
Sage Creek-Mckinnsey Reservoir	100500060109	96%	4%	0%	0%	92%	65%	35%
Upper Little Sage Creek	100500060201	87%	13%	0%	0%	50%	84%	16%
Varer Reservoir	100500060202	99%	1%	0%	0%	77%	65%	35%
Big Coulee	100500060203	89%	11%	0%	0%	58%	88%	12%
Lower Little Sage Creek	100500060204	82%	18%	0%	0%	20%	72%	28%
Fourmile Coulee	100500060301	90%	10%	0%	0%	57%	79%	21%
Upper O’Brien Coulee	100500060302	95%	5%	0%	0%	100%	34%	66%
Lower O’Brien Coulee	100500060303	100%	0%	0%	0%	61%	84%	16%
Middle O’Brien Coulee	100500060304	91%	9%	0%	0%	40%	85%	15%
Hingham Coulee	100500060401	82%	18%	0%	0%	0%	46%	54%
Upper England Coulee	100500060402	100%	0%	0%	0%	8%	97%	3%
Lower England Coulee	100500060403	94%	6%	0%	0%	3%	86%	14%
Sage Creek-Burkhartsmeyer Reservoir	100500060501	96%	4%	0%	0%	100%	41%	59%
Faulkners Coulee	100500060502	93%	7%	0%	0%	8%	80%	20%
Sage Creek-Sage Lake	100500060503	80%	20%	0%	0%	53%	70%	30%
Bailey Reservoir	100500060504	100%	0%	0%	0%	83%	48%	52%
Halfway Coulee	100500060505	90%	10%	0%	0%	16%	93%	7%
Lower Sage Creek	100500060506	97%	3%	0%	0%	41%	78%	22%
Creedman Coulee	100500070101	97%	1%	3%	0%	46%	57%	43%
Upper Lodger Creek	100500070102	91%	9%	0%	0%	3%	47%	53%
Middle Lodge Creek	100500070103	94%	4%	2%	0%	0%	54%	46%
Hay Coulee	100500070104	40%	30%	30%	0%	100%	50%	50%
Lower Lodger Creek	100500070105	87%	2%	11%	0%	33%	74%	26%
Upper East Fork Battle Creek	100500080101	36%	39%	25%	0%	15%	80%	20%
Middle East Fork Battle Creek	100500080102	50%	4%	46%	0%	6%	22%	78%
Lyons Coulee	100500080103	67%	1%	32%	0%	13%	79%	21%
Corral Coulee	100500080104	62%	5%	33%	0%	29%	58%	42%
100500080105	100500080105	54%	2%	44%	0%	80%	29%	71%
Lower East Fork Battle Creek	100500080106	66%	2%	32%	0%	0%	55%	45%
Upper Battle Creek	100500080201	66%	15%	19%	0%	93%	47%	53%
Middle Battle Creek	100500080202	84%	0%	16%	0%	1%	20%	80%
Chouteau Creek	100500080203	68%	3%	28%	1%	91%	58%	42%
Dry Fork Battle Creek	100500080204	74%	9%	16%	0%	62%	66%	34%
Coal Creek	100500080205	82%	3%	16%	0%	0%	60%	40%
Lower Battle Creek	100500080206	94%	5%	2%	0%	61%	47%	53%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Duck Creek	100500090101	18%	0%	0%	82%	58%	74%	26%
Little Peoples Creek	100500090102	0%	0%	2%	98%	31%	84%	16%
Jim Brown Creek	100500090103	0%	0%	0%	100%	94%	84%	16%
Lodge Pole Creek	100500090104	0%	0%	0%	100%	88%	75%	25%
South Fork Peoples Creek	100500090105	0%	0%	0%	100%	0%	83%	17%
Peoples Creek- South Branch Peoples Creek	100500090201	80%	20%	0%	0%	51%	76%	24%
Peoples Creek- Nicholson Bluff Creek	100500090202	95%	5%	0%	0%	25%	64%	36%
Peoples Creek-Maggie Creek	100500090203	51%	49%	0%	0%	35%	90%	10%
Peoples Creek-Saint Johns Coulee	100500090204	5%	16%	0%	79%	3%	90%	10%
Fogarty Coulee	100500090205	31%	11%	0%	58%	0%	73%	27%
Peoples Creek-Wildhorse Butte	100500090206	0%	0%	0%	100%	100%	82%	18%
Upper Lone Tree Coulee	100500090301	0%	0%	0%	100%	0%	95%	5%
Lower Lone Tree Coulee	100500090302	10%	0%	0%	90%	45%	43%	57%
Mud Creek	100500090401	0%	0%	0%	100%	7%	56%	44%
Peoples Creek-Corral Coulee	100500090402	65%	0%	9%	25%	42%	94%	6%
Peoples Creek-Willow Coulee	100500090403	0%	0%	0%	100%	0%	82%	18%
Upper Murray Coulee	100500100101	96%	3%	0%	1%	100%	98%	2%
Lower Murray Coulee	100500100102	97%	3%	0%	0%	4%	100%	0%
Turner	100500100201	95%	5%	0%	0%	96%	100%	0%
Buckley Creek	100500100202	95%	5%	0%	0%	89%	100%	0%
Woody Island Coulee- Silverbow Lake	100500100301	91%	2%	2%	4%	65%	95%	5%
Woody Island Coulee- 100500100302	100500100302	84%	5%	0%	11%	100%	96%	4%
Woody Island Coulee-Alkali Lake	100500100303	87%	1%	8%	4%	67%	99%	1%
Middle Woody Island Coulee	100500100304	37%	3%	59%	0%	100%	99%	1%
Woody Island Coulee- Buckley Creek	100500100305	90%	3%	7%	0%	2%	93%	7%
Woody Island Coulee-Big Butte	100500100306	74%	3%	23%	0%	36%	99%	1%
Woody Island Coulee- 100500100307	100500100307	82%	3%	16%	0%	21%	98%	2%
Lower Woody Island Coulee	100500100308	65%	6%	29%	0%	4%	91%	9%
Little Jewel Coulee	100500100401	78%	6%	16%	0%	99%	93%	7%
Coburg Coulee	100500100402	62%	1%	37%	0%	35%	80%	20%
Black Coulee	100500100403	67%	1%	31%	0%	29%	92%	8%
Headwaters Cottonwood Creek	100500100501	33%	9%	58%	0%	24%	86%	14%
Upper Cottonwood Creek	100500100502	71%	2%	27%	0%	100%	89%	11%
Middle Cottonwood Creek	100500100503	87%	2%	12%	0%	9%	91%	9%
Lambing Coulee	100500100504	27%	13%	60%	1%	59%	65%	35%
Lower Cottonwood Creek	100500100505	82%	4%	14%	0%	20%	88%	12%
Garland Creek	100500100506	71%	17%	13%	0%	70%	87%	13%
Pea Lake	100500110101	20%	1%	80%	0%	11%	92%	8%
Lester Reservoir	100500110102	62%	14%	24%	0%	57%	89%	11%
Upper East Fork Whitewater Creek	100500110103	58%	10%	32%	0%	99%	83%	17%
Lower East Fork Whitewater Creek	100500110104	61%	6%	31%	2%	80%	95%	5%
100500110201	100500110201	62%	4%	35%	0%	5%	96%	4%
Headwaters Cottonwood Coulee	100500110202	70%	3%	26%	1%	3%	97%	3%
Whitewater Creek- Cottonwood Coulee	100500110203	24%	3%	71%	3%	100%	94%	6%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Whitewater Creek-Lone Tree Coulee	100500110204	39%	3%	58%	0%	2%	94%	6%
Dibble Creek	100500110205	59%	1%	39%	2%	14%	93%	7%
Whitewater Creek-Austin Lake	100500110206	75%	2%	20%	2%	90%	92%	8%
Whitewater Creek-Clark Coulee	100500110207	75%	1%	23%	1%	18%	88%	12%
Whitewater Creek-Hymer Coulee	100500110208	78%	3%	19%	0%	18%	90%	10%
Lime Creek	100500120101	80%	3%	18%	0%	24%	30%	70%
Bear Creek	100500120102	87%	1%	11%	0%	95%	72%	28%
Upper Buggy Creek	100500120201	26%	40%	34%	0%	1%	56%	44%
Canyon Creek	100500120202	30%	0%	70%	0%	30%	20%	80%
Lower Buggy Creek	100500120203	59%	32%	9%	0%	8%	31%	69%
Hardscrabble Creek	100500120301	92%	0%	8%	0%	10%	20%	80%
Upper Antelope Creek	100500120302	46%	9%	44%	0%	99%	20%	80%
Lower Antelope Creek	100500120303	86%	1%	13%	0%	8%	28%	72%
Milk River-Hinsdale	100500120401	97%	2%	1%	0%	92%	86%	14%
Milk River-Buffalo Coulee	100500120402	97%	0%	3%	0%	0%	54%	46%
Mooney Coulee	100500120403	41%	0%	59%	0%	5%	42%	58%
Milk River-Tampico	100500120404	80%	16%	4%	0%	93%	89%	11%
Upper Brazil Creek	100500120501	9%	3%	88%	0%	100%	20%	80%
Lower Brazil Creek	100500120502	84%	1%	14%	0%	0%	0%	100%
Upper Cherry Creek	100500120601	31%	64%	5%	0%	0%	68%	32%
Upper East Fork Cherry Creek	100500120602	75%	2%	23%	0%	9%	45%	55%
Lower East Fork Cherry Creek	100500120603	76%	14%	10%	0%	100%	49%	51%
Lower Cherry Creek	100500120604	88%	1%	11%	0%	0%	74%	26%
South Fork Lone Tree Creek	100500120701	68%	0%	32%	0%	100%	0%	100%
North Fork Lone Tree Creek	100500120702	0%	0%	100%	0%	0%	5%	95%
Lone Tree Creek	100500120703	26%	4%	71%	0%	100%	8%	92%
Upper Little Beaver Creek	100500120801	0%	0%	100%	0%	100%	4%	96%
Middle Little Beaver Creek	100500120802	0%	6%	94%	0%	94%	3%	97%
South Fork Little Beaver Creek	100500120803	5%	0%	95%	0%	11%	1%	99%
Lower Little Beaver Creek	100500120804	0%	8%	92%	0%	1%	1%	99%
Headwaters Willow Creek	100500120901	2%	11%	87%	0%	1%	3%	97%
Desert Coulee	100500120902	84%	0%	16%	0%	0%	2%	98%
Hard Pan Creek	100500120903	0%	0%	100%	0%	64%	7%	93%
Willow Creek-Collins Reservoir	100500120904	25%	8%	67%	0%	82%	0%	100%
Willow Creek-Pearson Coulee	100500120905	11%	0%	89%	0%	0%	0%	100%
Willow Creek-Wilderness Coulee	100500120906	0%	0%	100%	0%	14%	0%	100%
Willow Creek-Archambeault Flats	100500120907	15%	0%	85%	0%	48%	1%	99%
Willow Creek-Dry Lake	100500120908	94%	3%	4%	0%	73%	89%	11%
Milk River-Glasgow	100500121001	100%	0%	0%	0%	97%	77%	23%
Milk River-Nashua	100500121002	98%	2%	0%	0%	0%	96%	4%
Milk River Coulee	100500121003	0%	0%	0%	100%	0%	95%	5%
Lower Milk River	100500121004	7%	0%	0%	93%	30%	93%	7%
Frenchman Creek-Canada	100500130101	74%	3%	23%	0%	0%	85%	15%
Frenchman Creek-Peck Coulee	100500130102	67%	20%	14%	0%	38%	85%	15%
Cottonwood Creek	100500130103	41%	11%	49%	0%	0%	52%	48%
Corral Coulee	100500130104	77%	0%	23%	0%	0%	61%	39%
Frenchman Creek-Frenchman Reservoir	100500130105	93%	3%	4%	0%	75%	78%	22%
Frenchman Creek-Panhandle Coulee	100500130106	95%	4%	1%	0%	3%	71%	29%
Lower Frenchman Creek	100500130107	88%	11%	0%	1%	19%	90%	10%

Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

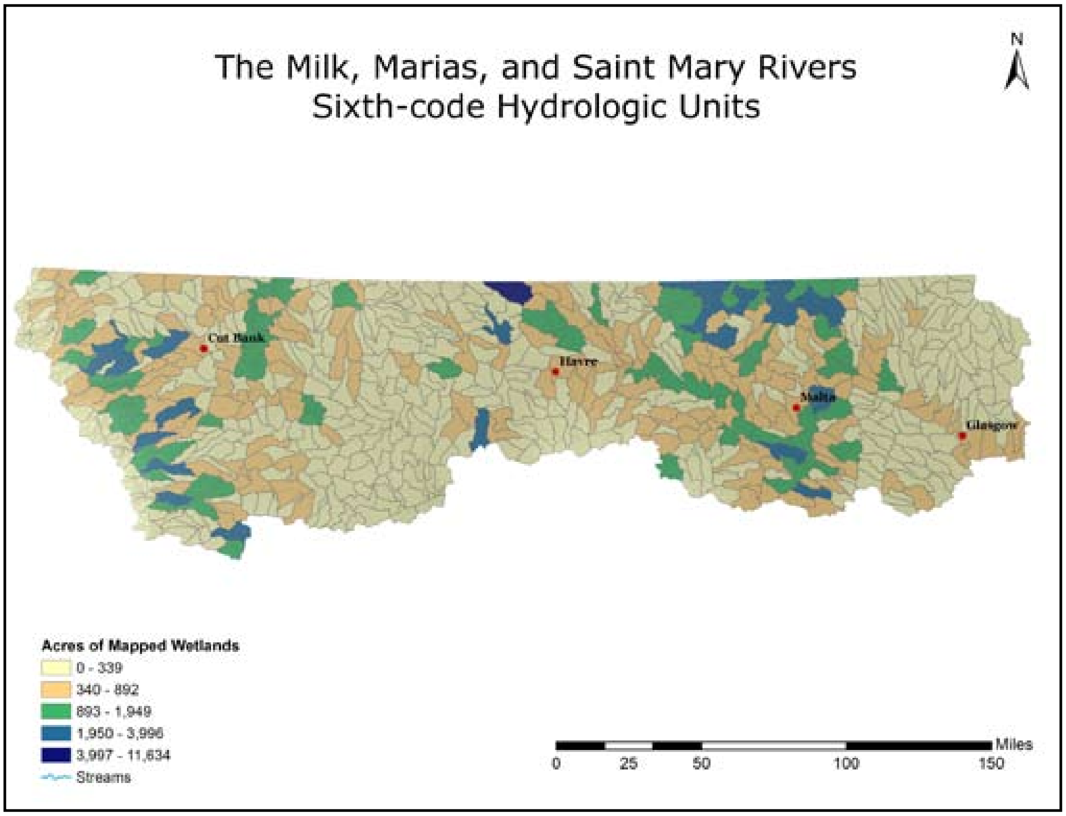
6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Upper Big Warm Creek	100500140101	12%	0%	3%	85%	100%	65%	35%
Middle Big Warm Creek	100500140102	72%	0%	7%	21%	100%	45%	55%
Little Warm Creek	100500140103	76%	10%	7%	8%	6%	74%	26%
Chicken Coulee	100500140104	8%	0%	0%	92%	0%	72%	28%
Tressler Coulee	100500140105	86%	6%	6%	2%	21%	78%	22%
Wild Horse Creek	100500140106	80%	1%	8%	11%	96%	49%	51%
White Rock Coulee	100500140107	58%	3%	39%	0%	5%	57%	43%
Lower Big Warm Creek	100500140108	56%	7%	37%	0%	0%	76%	24%
Beaver Creek-Bear Gulch	100500140201	32%	17%	1%	51%	5%	47%	53%
Beaver Creek-Coburn Butte	100500140202	51%	1%	48%	0%	0%	60%	40%
Veseth Reservoir	100500140203	62%	1%	37%	0%	21%	23%	77%
Beaver Creek-Holzhey Reservoir	100500140204	48%	2%	50%	0%	12%	59%	41%
Beaver Creek-100500140205	100500140205	84%	4%	12%	0%	51%	77%	23%
Beaver Creek-Nelson Coulee	100500140206	76%	4%	20%	0%	6%	86%	14%
Beaver Creek-Horse Pasture Coulee	100500140207	53%	7%	40%	0%	63%	80%	20%
First Creek	100500140301	47%	7%	46%	0%	59%	52%	48%
Sun Prairie Flats	100500140302	79%	2%	20%	0%	9%	65%	35%
Sheep Coulee	100500140303	56%	1%	43%	0%	0%	64%	36%
Flat Creek	100500140304	92%	0%	8%	0%	100%	88%	12%
Sage Creek	100500140305	74%	7%	19%	0%	19%	0%	100%
Little Sevenmile Creek	100500140306	65%	1%	34%	0%	67%	85%	15%
Tallow Creek	100500140307	86%	0%	14%	0%	93%	0%	100%
Spring Creek	100500140308	40%	6%	54%	0%	0%	19%	81%
Flat Creek	100500140309	83%	0%	16%	0%	97%	59%	41%
DHS Creek	100500140401	90%	5%	5%	0%	54%	58%	42%
Beaver Creek-Grove Coulee	100500140402	69%	1%	30%	0%	97%	68%	32%
Beaver Creek-Pickhandle	100500140403	76%	3%	21%	0%	98%	71%	29%
Sevenmile Creek	100500140404	98%	2%	0%	0%	2%	86%	14%
Moss Coulee	100500140405	96%	0%	3%	0%	4%	65%	35%
Beaver Creek-Guston Coulee	100500140406	77%	8%	15%	0%	100%	92%	8%
Beaver Creek-Lenoir Coulee	100500140407	89%	4%	7%	0%	0%	74%	26%
Black Coulee	100500140501	36%	1%	62%	0%	46%	81%	19%
Lake Bowdion	100500140502	33%	2%	65%	0%	77%	99%	1%
Larb Creek-Ten Trees Creek	100500140601	41%	3%	55%	0%	59%	29%	71%
Larb Creek-Craig Coulee	100500140602	30%	6%	65%	0%	74%	22%	78%
Larb Creek-Grant Coulee	100500140603	19%	1%	80%	0%	0%	18%	82%
Larb Creek-Box Elder Coulee	100500140604	53%	0%	47%	0%	23%	54%	46%
Larb Creek-Whites Coulee	100500140605	46%	0%	54%	0%	11%	54%	46%
Larb Creek-Lost Coulee	100500140606	71%	6%	23%	0%	4%	42%	58%
Square Creek	100500140607	82%	0%	18%	0%	32%	26%	74%
Fourth Creek	100500140608	88%	1%	11%	0%	0%	8%	92%
McNab Coulee	100500140609	66%	0%	34%	0%	20%	41%	59%
Second Creek	100500140610	52%	0%	48%	0%	34%	32%	68%
First Creek	100500140611	66%	3%	31%	0%	2%	29%	71%
Larb Creek-Third Creek	100500140612	93%	4%	4%	0%	0%	56%	44%
Beaver Creek-Gilbertson Coulee	100500140701	95%	2%	2%	0%	100%	89%	11%
Nelson Reservoir	100500140702	63%	3%	34%	0%	68%	98%	2%
Beaver Creek-Hay Coulee	100500140703	58%	6%	36%	0%	35%	93%	7%
Beaver Creek-Nelson South Canal	100500140704	97%	1%	2%	0%	0%	77%	23%
Beaver Creek-Limekiln Coulee	100500140705	94%	5%	1%	0%	43%	95%	5%
Morgan Creek	100500150101	96%	0%	4%	0%	0%	19%	81%
Upper Rock Creek	100500150102	28%	0%	72%	0%	58%	59%	41%

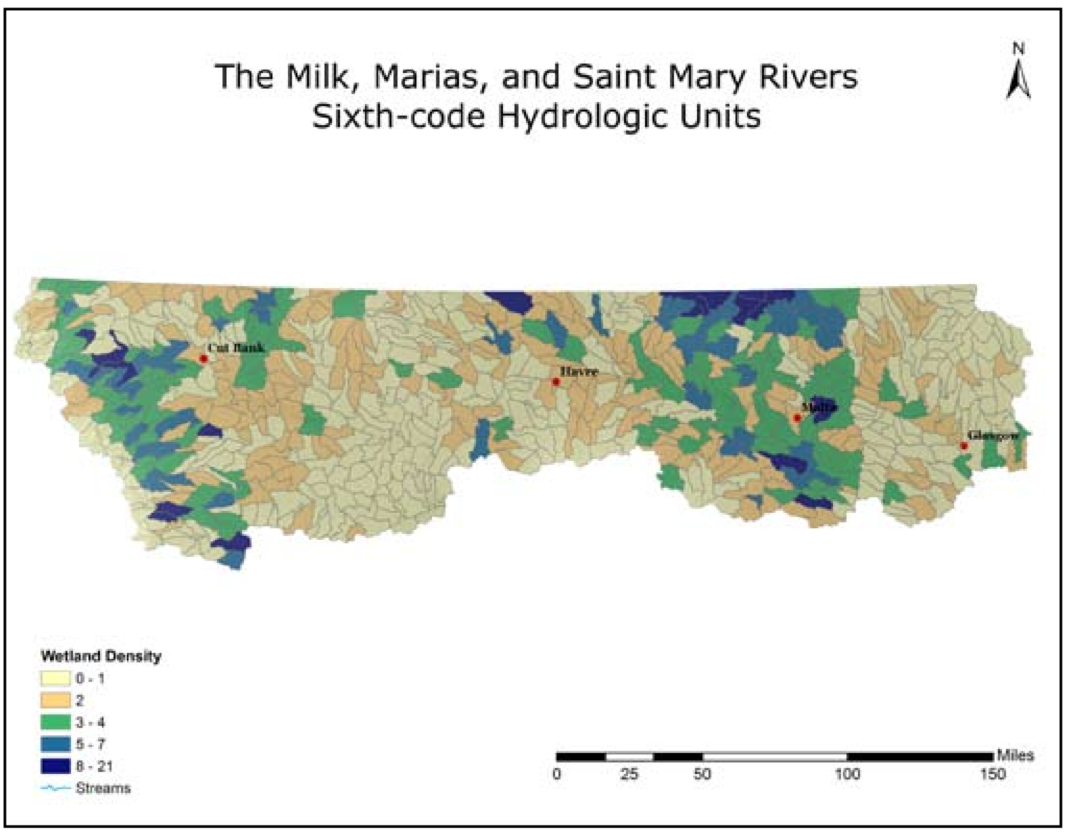
Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

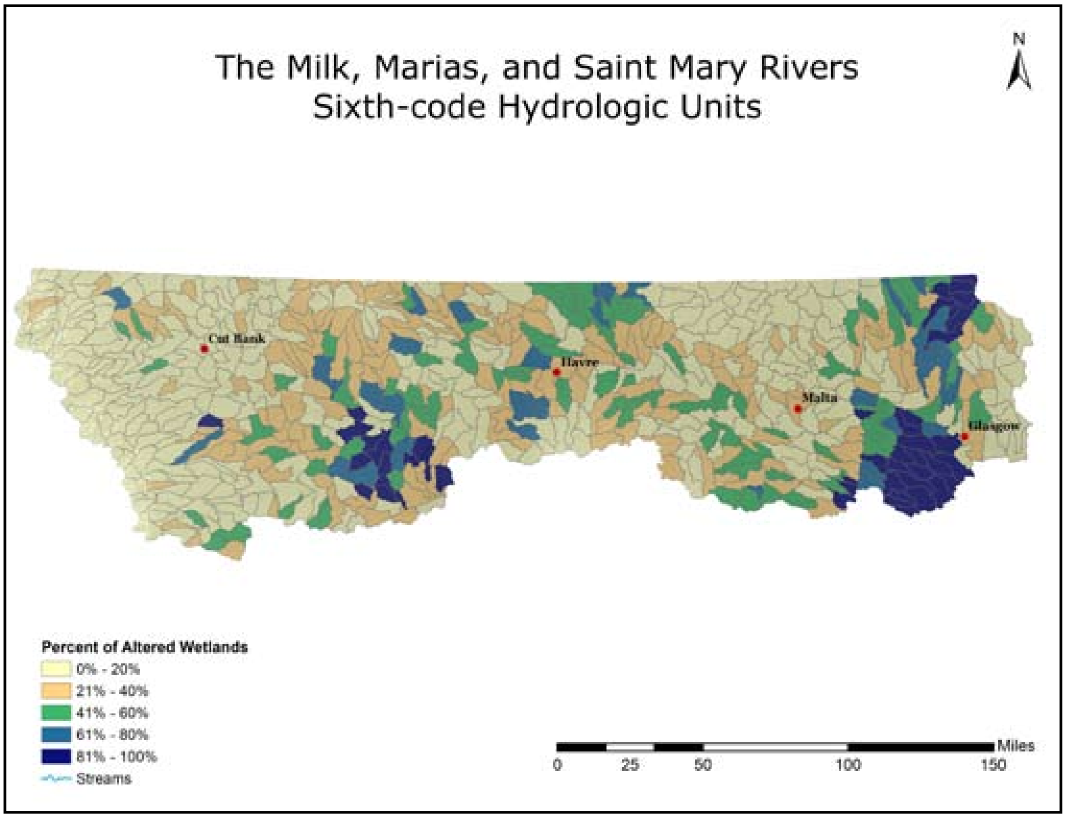
6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
North Fork South Creek	100500150201	44%	2%	54%	0%	100%	14%	86%
South Creek	100500150202	30%	0%	70%	0%	0%	17%	83%
East Fork Crow Creek	100500150301	11%	12%	77%	0%	54%	48%	52%
Crow Creek	100500150302	47%	4%	49%	0%	74%	39%	61%
Jack Creek	100500150401	79%	1%	20%	0%	45%	44%	56%
Big Snake Creek	100500150402	58%	2%	40%	0%	86%	52%	48%
Upper Willow Creek	100500150501	65%	3%	32%	0%	4%	17%	83%
Lone Tree Coulee	100500150502	0%	2%	98%	0%	4%	3%	97%
Middle Willow Creek	100500150503	15%	15%	70%	0%	19%	23%	77%
Deep Creek	100500150504	16%	11%	73%	0%	0%	20%	80%
Bitter Creek	100500150505	0%	0%	100%	0%	0%	23%	77%
Chisholm Creek	100500150506	32%	2%	66%	0%	1%	15%	85%
Eagle Creek	100500150507	8%	8%	85%	0%	0%	22%	78%
Lower Willow Creek	100500150508	87%	8%	6%	0%	0%	26%	74%
McEachern Creek	100500150601	86%	0%	14%	0%	0%	24%	76%
Bluff Creek	100500150602	39%	2%	59%	0%	99%	45%	55%
Rock Creek-Thoeny School	100500150603	47%	0%	52%	0%	54%	72%	28%
Rock Creek-Lake Grable	100500150604	34%	2%	64%	0%	9%	56%	44%
Rock Creek-Rock Creek Canyon	100500150605	58%	2%	40%	0%	0%	75%	25%
Cache Coulee	100500150606	86%	8%	6%	0%	45%	74%	26%
Lower Rock Creek	100500150607	74%	8%	18%	0%	0%	67%	33%
Bog Coulee	100500160101	97%	3%	0%	0%	0%	80%	20%
Headwaters of Snow Coulee	100500160102	87%	0%	0%	13%	90%	76%	24%
East Fork Snow Coulee	100500160103	79%	0%	0%	20%	0%	85%	15%
Lower Snow Coulee	100500160104	5%	0%	0%	95%	4%	96%	4%
Upper Middle Fork Porcupine Creek	100500160201	100%	0%	0%	0%	0%	60%	40%
Middle Middle Fork Porcupine Creek	100500160202	94%	3%	1%	2%	0%	67%	33%
Lower Middle Fork Porcupine Creek	100500160203	7%	1%	0%	92%	27%	86%	14%
Upper West Fork Porcupine Creek	100500160301	18%	11%	72%	0%	13%	60%	40%
Lower West Fork Porcupine Creek	100500160302	24%	55%	3%	18%	0%	91%	9%
Upper East Fork Porcupine Creek	100500160401	0%	0%	0%	100%	33%	80%	20%
Lower East Fork Porcupine Creek	100500160402	0%	0%	0%	100%	49%	86%	14%
Dry Fork Creek	100500160501	8%	91%	1%	0%	7%	88%	12%
Porcupine Creek-Olson Spring	100500160502	24%	54%	3%	18%	0%	74%	26%
Porcupine Creek-Enright Coulee	100500160503	64%	15%	3%	18%	0%	86%	14%
Porcupine Creek-Johnson Coulee	100500160504	3%	0%	8%	89%	18%	86%	14%
Sargent Creek	100500160505	0%	0%	0%	100%	0%	88%	12%
Lower Porcupine Creek	100500160506	2%	0%	0%	98%	0%	92%	8%
Galpin Coulee	100600010101	0%	0%	0%	0%	0%	0%	0%
Missouri River-Fort Peck Dam	100600010102	0%	0%	0%	0%	0%	0%	0%
Upper East Fork Little Porcupine Creek	100600010201	0%	0%	0%	0%	0%	0%	0%
West Fork Little Porcupine	100600010203	0%	0%	0%	0%	0%	0%	0%
Tomato Can Creek	100600010301	0%	0%	0%	0%	11%	0%	0%
Upper Charley Creek	100600010302	0%	0%	0%	100%	2%	100%	0%
Lower Charley Creek	100600010303	0%	0%	0%	0%	0%	0%	0%
Lower Little Porcupine Creek	100600010304	0%	0%	0%	0%	0%	0%	0%
Missouri River-Lost Creek	100600010802	0%	0%	0%	0%	0%	0%	0%
Lower Roanwood Creek	100600040101	0%	0%	0%	0%	0%	0%	0%

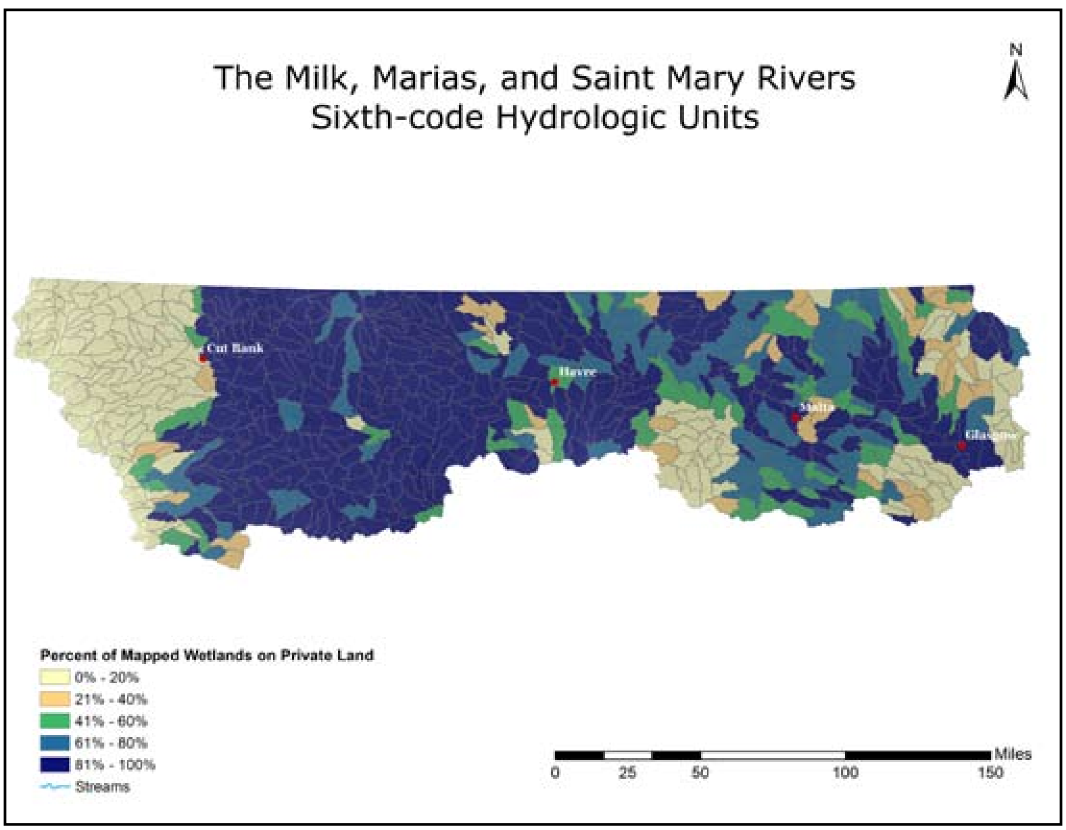
Wetland Landscape Profiling of Palustrine Wetlands: Sixth-Code Hydrological Unit

6th Code HUC Name	HUC Number	Private	State	Federal	Tribal	Protected	Natural	Altered
Upper Roanwood Creek	100600040102	0%	0%	0%	0%	42%	0%	0%
West Fork Poplar River-Happy Valley	100600040201	0%	0%	0%	0%	0%	0%	0%
Spring Coulee	100600040204	0%	0%	0%	0%	0%	0%	0%
West Fork Poplar River-Dolson Coulee	100600040205	0%	0%	0%	0%	14%	0%	0%
Upper Hell Creek	100600040301	0%	0%	0%	0%	0%	0%	0%
Strawberry Creek	170102070101	0%	0%	0%	0%	0%	0%	0%
Middle Fork Flathead River-Trail Creek	170102070102	0%	0%	0%	0%	0%	0%	0%
Bowl Creek	170102070103	0%	0%	0%	0%	19%	0%	0%
Cox Creek	170102070104	0%	0%	0%	0%	0%	0%	0%
Morrison Creek	170102070201	0%	0%	0%	0%	0%	0%	0%
Granite Creek	170102070203	0%	0%	0%	0%	0%	0%	0%
Middle Fork Flathead River-Bear Creek	170102070301	0%	0%	0%	0%	0%	0%	0%
Ole Creek	170102070303	0%	0%	0%	0%	0%	0%	0%
Park Creek	170102070304	0%	0%	0%	0%	29%	0%	0%
Upper Nyack Creek	170102070401	0%	0%	0%	0%	92%	0%	0%
Harrison Creek	170102070403	0%	0%	0%	0%	0%	0%	0%
Lincoln Creek	170102070404	0%	0%	0%	0%	0%	0%	0%
McDonald Creek Headwaters	170102070501	0%	0%	0%	0%	0%	0%	0%
McDonald Creek	170102070502	0%	0%	100%	0%	0%	100%	0%

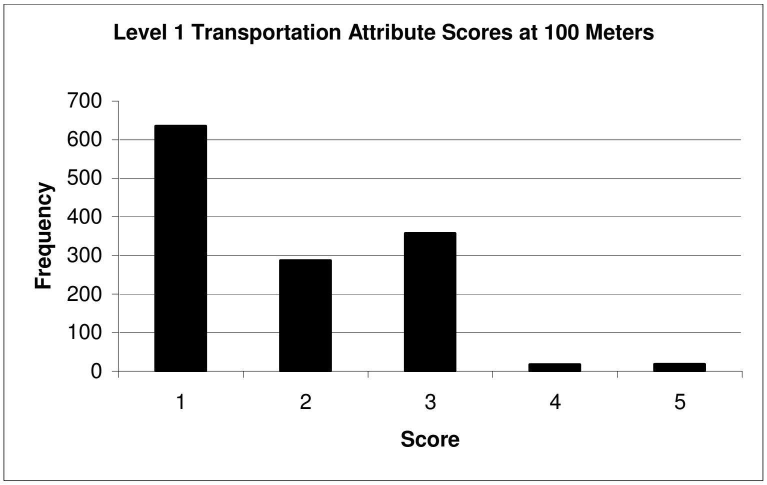

The Milk, Marias, and Saint Mary Rivers
Sixth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Acres of Mapped Wetlands
0 - 339
340 - 892
893 - 1,949
1,950 - 3,996
3,997 - 11,634
Streams
Miles
0
25
50
100
150

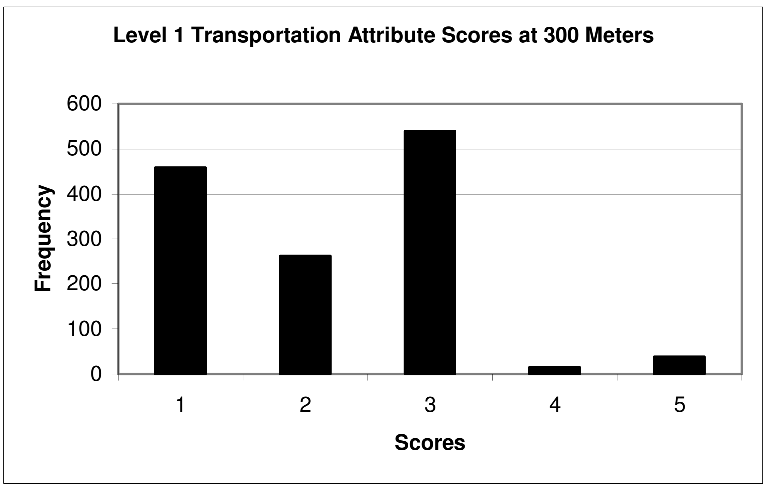

The Milk, Marias, and Saint Mary Rivers
Sixth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Wetland Density
0 - 1
2
3 - 4
5 - 7
8 - 21
Streams
Miles
0
25
50
100
150

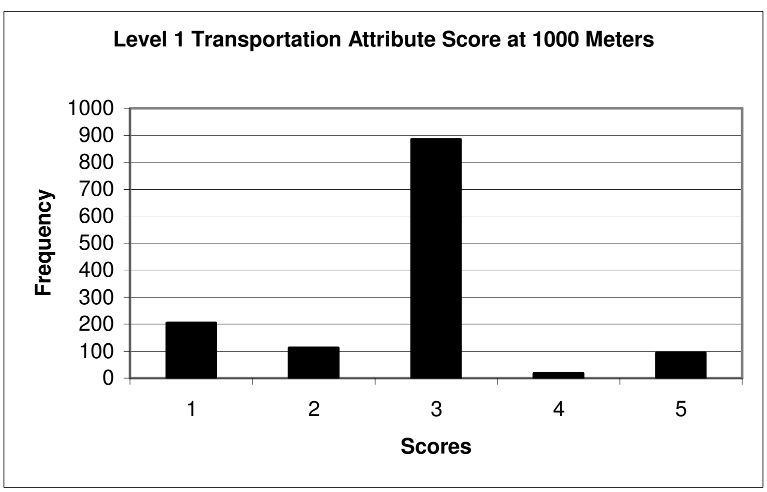

The Milk, Marias, and Saint Mary Rivers
Sixth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Percent of Altered Wetlands
0% - 20%
21% - 40%
41% - 60%
61% - 80%
81% - 100%
Streams
Miles
0
25
50
100
150

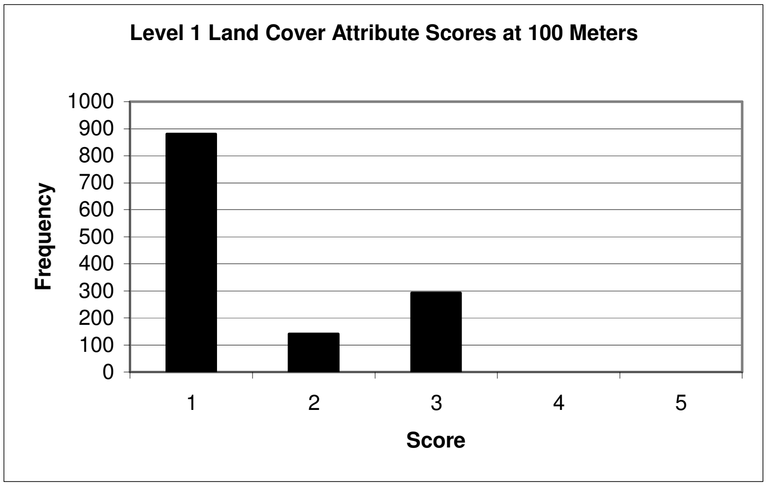

The Milk, Marias, and Saint Mary Rivers
Sixth-code Hydrologic Units
N
Cut Bank
Havre
Malta
Glasgow
Percent of Mapped Wetlands on Private Land
0% - 20%
21% - 40%
41% - 60%
61% - 80%
81% - 100%
Streams
Miles
0
25
50
100
150

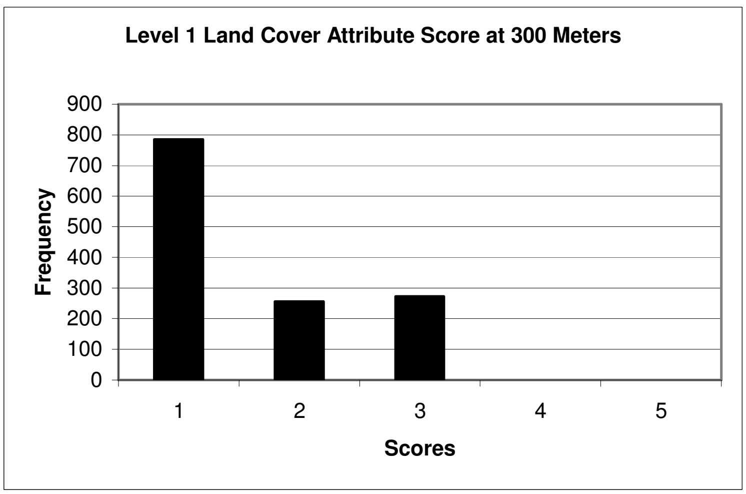
Appendix J. Level 1 Attribute Frequency Histograms for Three Landscape Scales

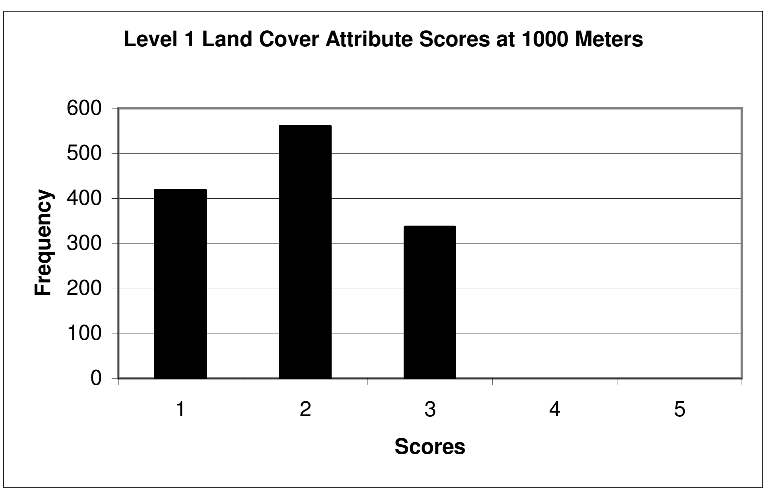

Level 1 Transportation Attribute Scores at 100 Meters
Frequency
0
100
200
300
400
500
600
700
1
2
3
4
5
Score

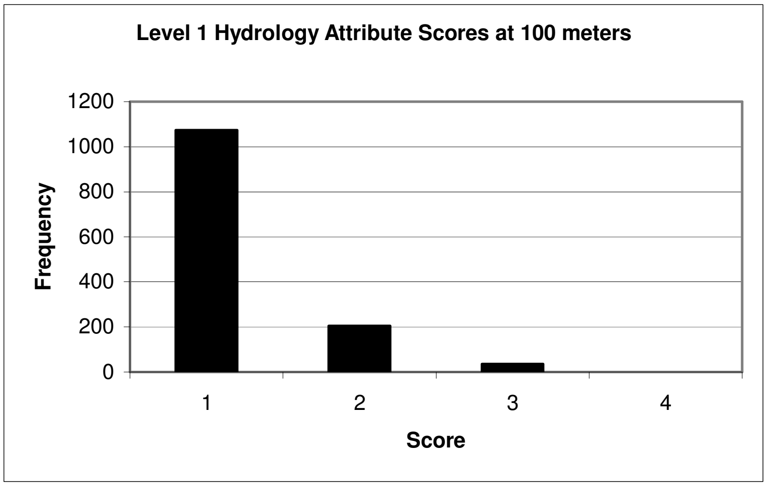

Level 1 Transportation Attribute Scores at 300 Meters
Frequency
0
100
200
300
400
500
600
1
2
3
4
5
Scores

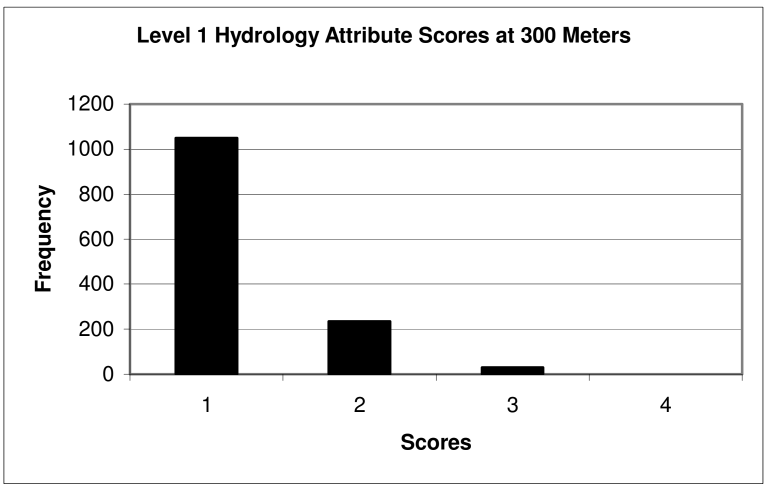

Level 1 Transportation Attribute Score at 1000 Meters
Frequency
0
100
200
300
400
500
600
700
800
900
1000
1
2
3
4
5
Scores

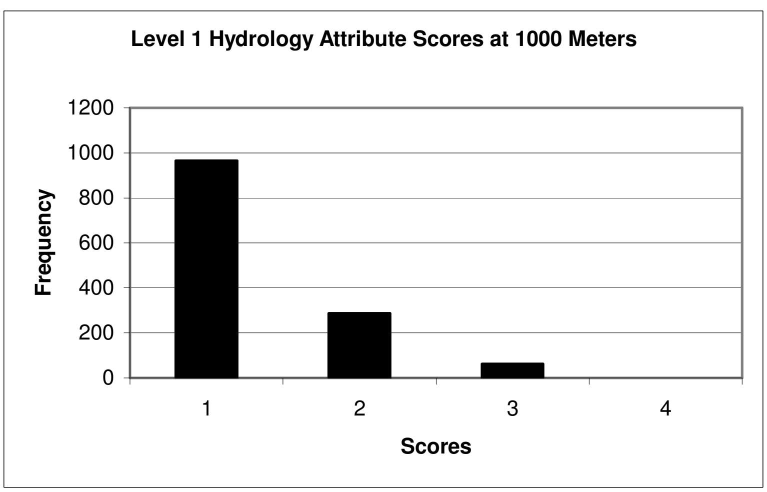

Level 1 Land Cover Attribute Scores at 100 Meters
Frequency
1000
900
800
700
600
500
400
300
200
100
0
1
2
3
4
5
Score

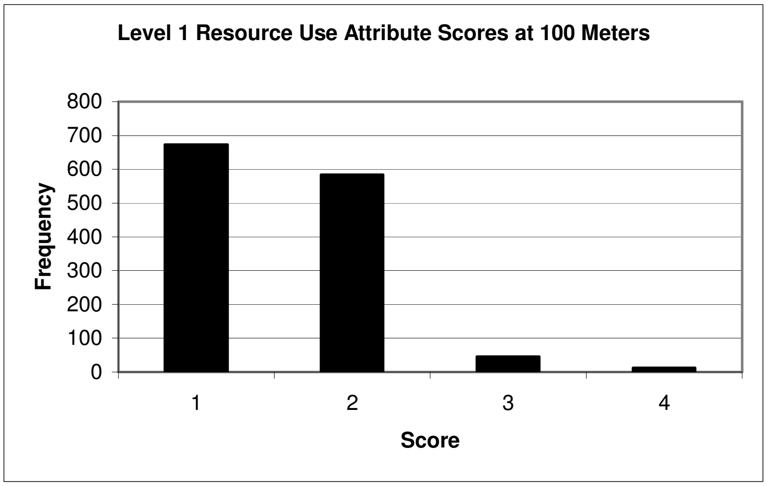

Level 1 Land Cover Attribute Score at 300 Meters
Frequency
900
800
700
600
500
400
300
200
100
0
1
2
3
4
5
Scores

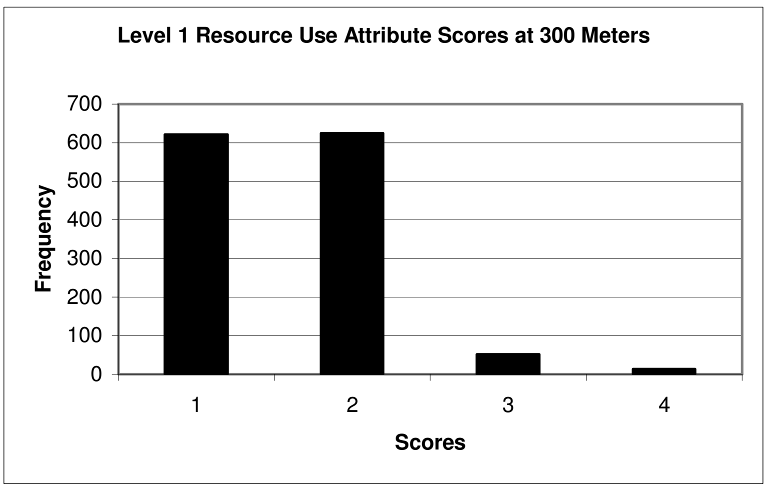

Level 1 Land Cover Attribute Scores at 1000 Meters
Frequency
600
500
400
300
200
100
0
1
2
3
4
5
Scores

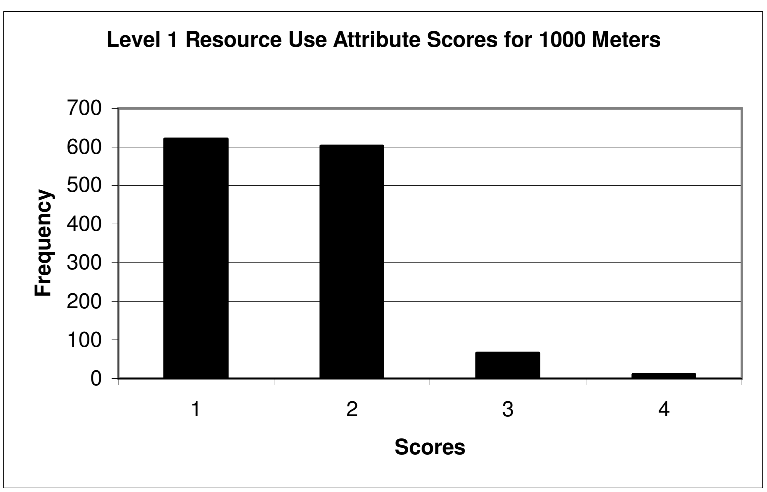

Level 1 Hydrology Attribute Scores at 100 meters
1200
1000
800
600
400
200
0
Frequency
1
2
3
4
Score

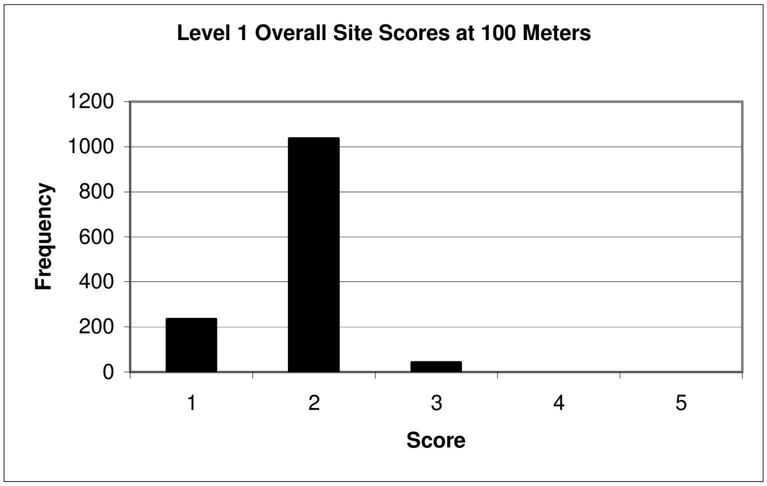

Level 1 Hydrology Attribute Scores at 300 Meters
1200
1000
800
600
400
200
0
Frequency
1
2
3
4
Scores

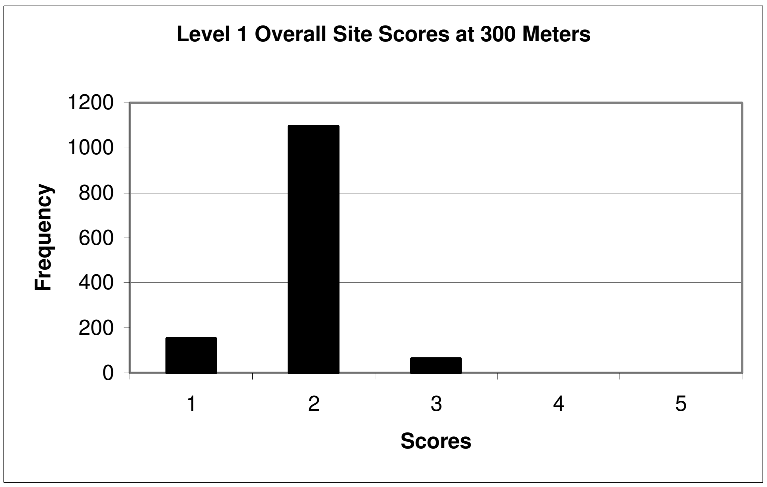

Level 1 Hydrology Attribute Scores at 1000 Meters
1200
1000
800
600
400
200
0
Frequency
1
2
3
4
Scores

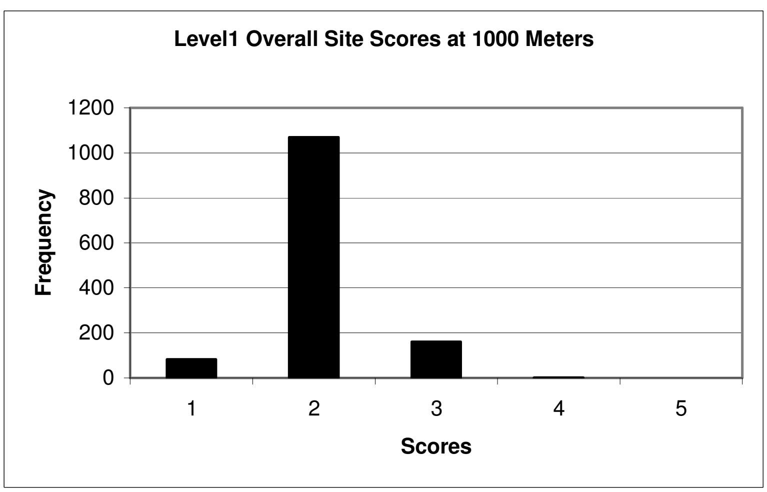

Level 1 Resource Use Attribute Scores at 100 Meters
800
700
600
500
400
300
200
100
0
Frequency
1
2
3
4
Score


Level 1 Resource Use Attribute Scores at 300 Meters
700
600
500
400
300
200
100
0
Frequency
1
2
3
4
Scores

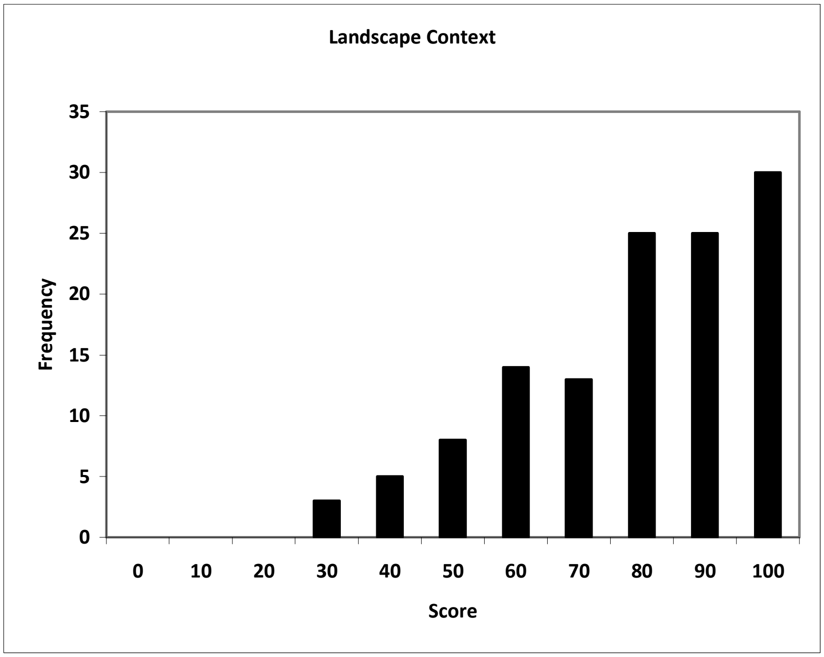

Level 1 Resource Use Attribute Scores for 1000 Meters
700
600
500
400
300
200
100
0
Frequency
1
2
3
4
Scores

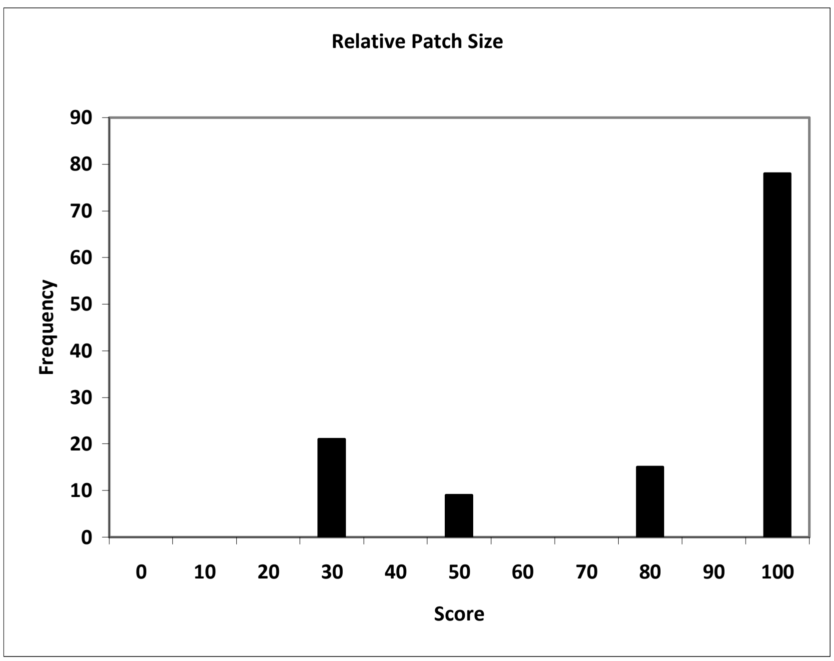

Level 1 Overall Site Scores at 100 Meters
Frequency
1200
1000
800
600
400
200
0
1
2
3
4
5
Score

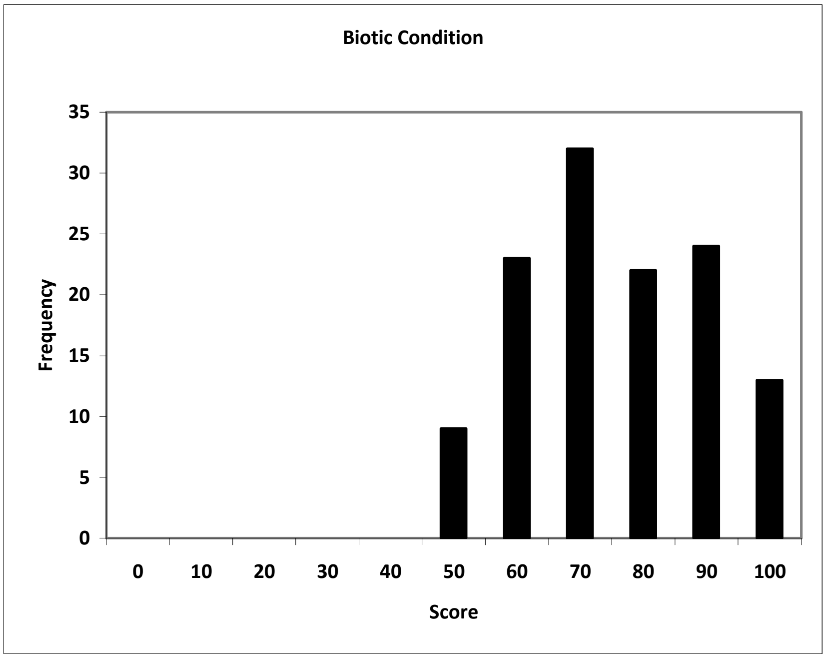

Level 1 Overall Site Scores at 300 Meters
Frequency
1200
1000
800
600
400
200
0
1
2
3
4
5
Scores

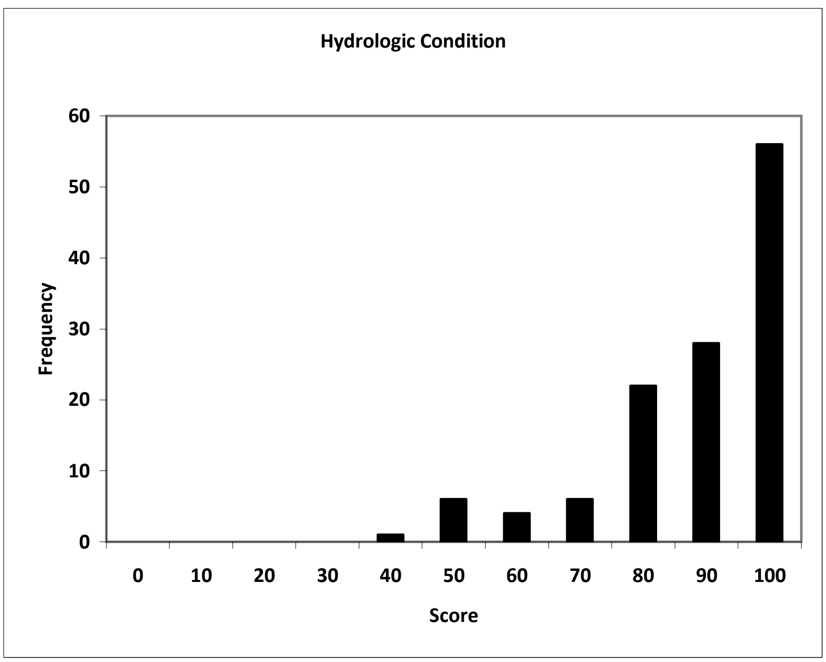

Level1 Overall Site Scores at 1000 Meters
Frequency
1200
1000
800
600
400
200
0
1
2
3
4
5
Scores

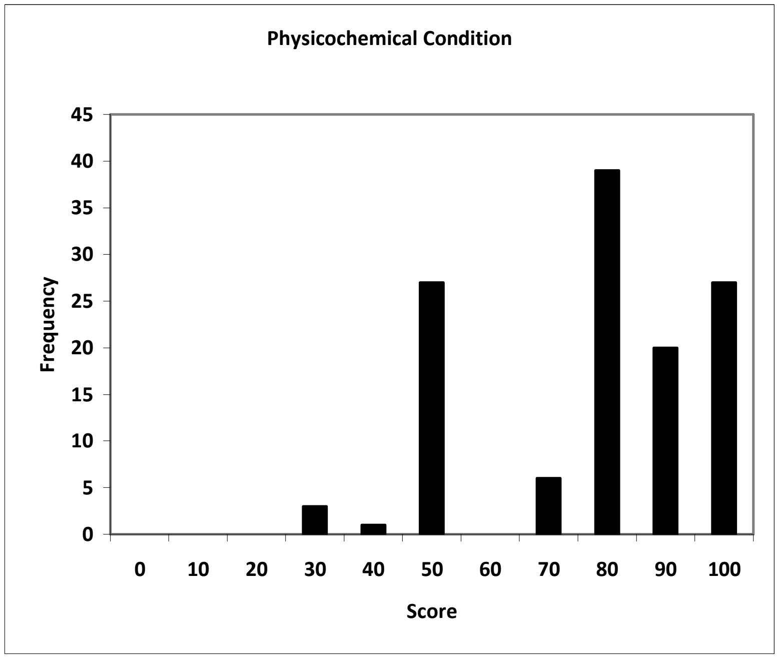
APPENDIX K. LEVEL 2 ATTRIBUTE FREQUENCY HISTOGRAMS


Landscape Context
35
30
25
20
15
10
5
0
Frequency
0
10
20
30
40
50
60
70
80
90
100
Score


Relative Patch Size
90
80
70
60
50
40
30
20
10
0
Frequency
0
10
20
30
40
50
60
70
80
90
100
Score


Biotic Condition
35
30
25
20
15
10
5
0
Frequency
0
10
20
30
40
50
60
70
80
90
100
Score


Hydrologic Condition
60
50
40
30
20
10
0
Frequency
0
10
20
30
40
50
60
70
80
90
100
Score


Physicochemical Condition
45
40
35
30
25
20
15
10
5
0
Frequency
0
10
20
30
40
50
60
70
80
90
100
Score

APPENDIX L. LEVEL 2 SCORES FOR EACH ECOLOGICAL SYSTEM

Great Plains Prairie Pothole N=19

	Mean	S.D.	Min	Max
Landscape Condition	83.6	14.5	55.6	100.0
Patch Size	82.9	26.4	25.0	100.0
Biotic	79.5	11.3	52.8	94.4
Hydrologic	89.9	12.6	66.7	100.0
Physiochemical	82.2	19.7	25.0	100.0
Total AA	83.6	11.1	57.5	98.3

North American Arid West Emergent Marsh N=5

	Mean	S.D.	Min	Max
Landscape Condition	66.2	19.1	42.7	93.3
Patch Size	100.0	0.0	100.0	100.0
Biotic	76.7	14.8	55.6	88.9
Hydrologic	80.0	19.2	50.0	100.0
Physiochemical	87.5	15.3	62.5	100.0
Total AA	82.1	6.5	74.9	89.8

Northwestern Great Plains Riparian N=15

	Mean	S.D.	Min	Max
Landscape Condition	77.0	15.6	50.0	100.0
Patch Size	68.3	34.7	25.0	100.0
Biotic	65.9	13.0	41.7	88.9
Hydrologic	81.7	19.7	50.0	100.0
Physiochemical	68.3	22.1	25.0	100.0
Total AA	72.2	12.1	53.2	92.2

Rocky Mountain Alpine-Montane Wet Meadow N=6

	Mean	S.D.	Min	Max
Landscape Condition	67.7	23.2	35.8	100.0
Patch Size	95.8	10.2	75.0	100.0
Biotic	82.9	11.6	66.7	97.2
Hydrologic	87.5	17.3	58.3	100.0
Physiochemical	93.8	10.5	75.0	100.0
Total AA	85.5	10.2	71.6	98.3

Western Great Plains Closed Depression Wetland N=13

	Mean	S.D.	Min	Max
Landscape Condition	64.8	18.7	30.2	90.3
Patch Size	76.9	33.0	25.0	100.0
Biotic	67.3	11.6	55.6	91.7
Hydrologic	84.6	19.5	33.3	100.0
Physiochemical	73.1	21.6	25.0	100.0
Total AA	73.4	13.7	42.7	87.7

Western Great Plains Open Freshwater Depression Wetland N=49

	Mean	S.D.	Min	Max
Landscape Condition	71.3	26.1	25.0	100.0
Patch Size	77.0	24.1	25.0	100.0
Biotic	65.5	15.8	41.7	91.7
Hydrologic	83.2	16.7	50.0	100.0
Physiochemical	69.9	14.8	37.5	100.0
Total AA	73.4	11.7	47.7	98.3

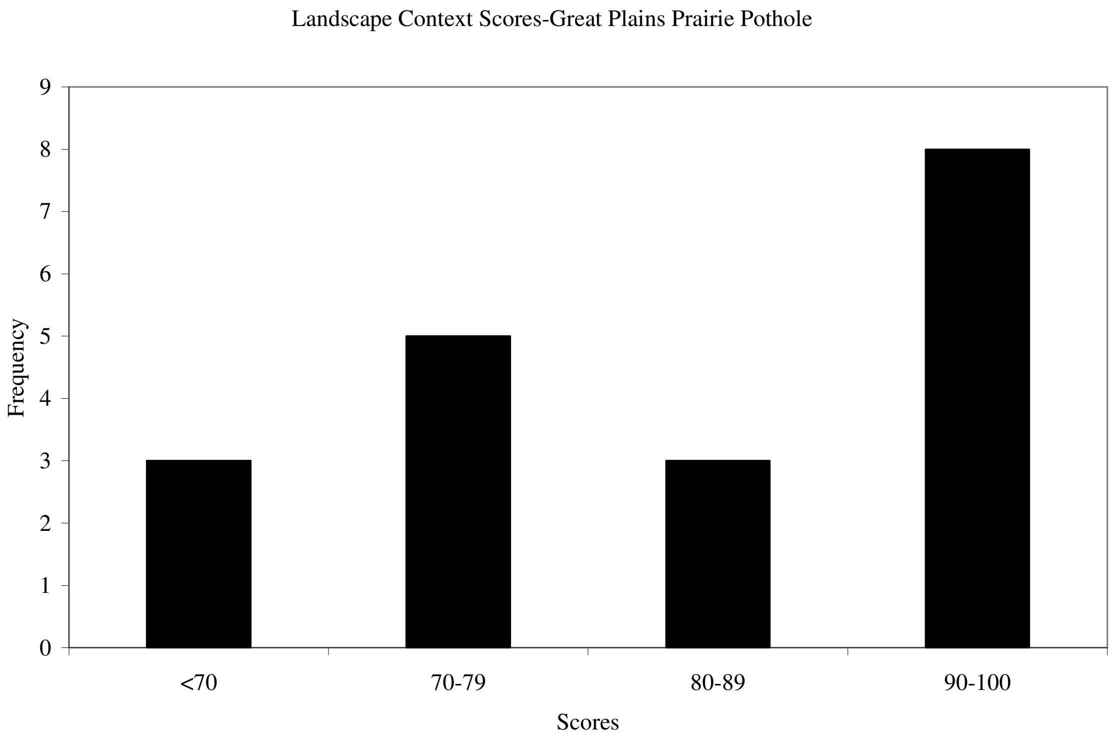
Western Great Plains Saline Depression Wetland N=8

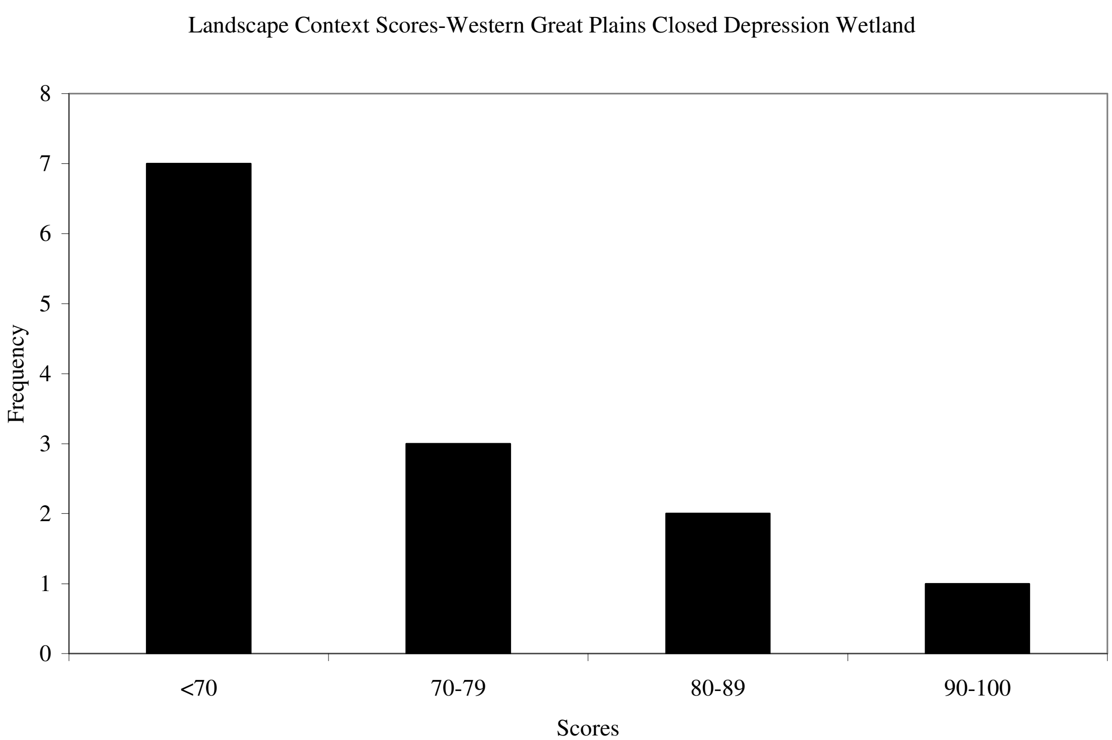
	Mean	S.D.	Min	Max
Landscape Condition	86.2	11.3	67.0	100.0
Patch Size	96.9	8.8	75.0	100.0
Biotic	76.7	13.3	58.3	97.2
Hydrologic	93.8	7.4	83.3	100.0
Physiochemical	82.8	16.3	50.0	100.0
Total AA	87.3	7.9	73.7	96.7

Rocky Mountain Subalpine-Montane Riparian Shrubland N=2

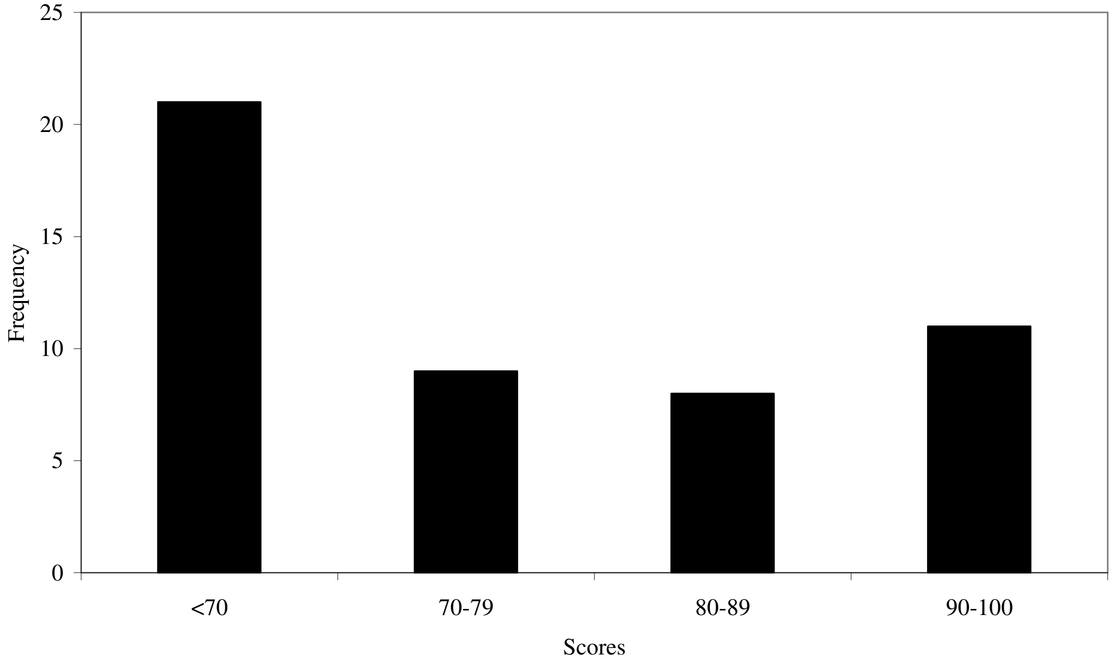
	Mean	S.D.	Min	Max
Landscape Condition	93.8	8.8	87.5	100.0
Patch Size	100.0	0.0	100.0	100.0
Biotic	88.9	7.9	83.3	94.4
Hydrologic	100.0	0.0	100.0	100.0
Physiochemical	87.5	17.7	75.0	100.0
Total AA	94.0	3.3	91.7	96.4

Appendix M. Level 2 Attribute and Overall Condition Score Frequency Histograms by Wetland Ecological Systems with $N = \geq 8$ Sites

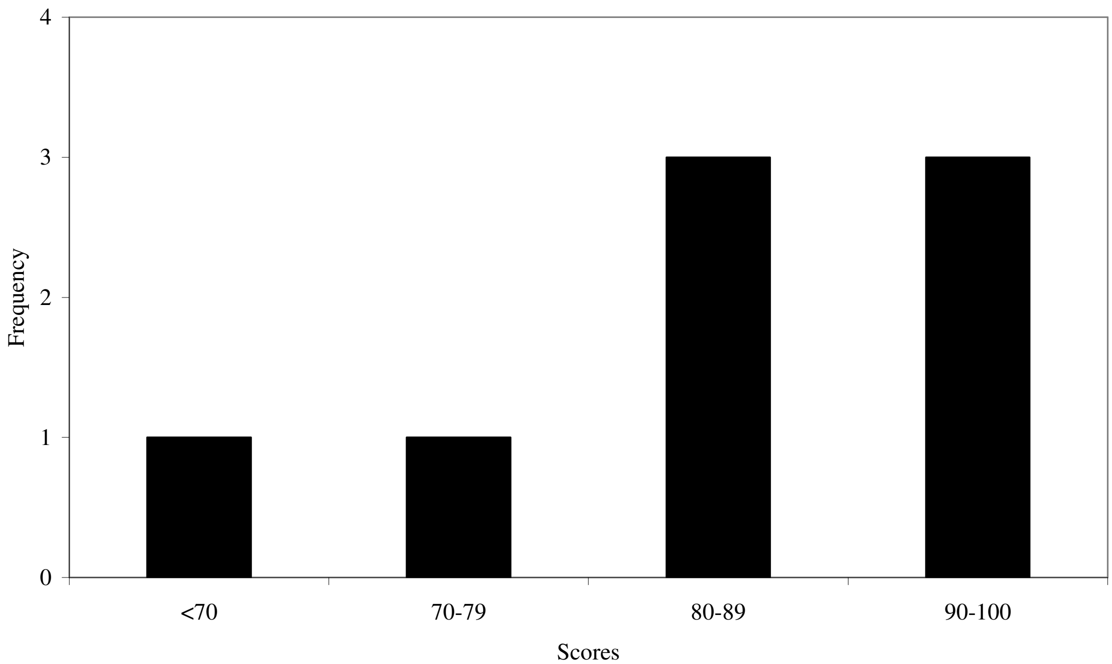

Landscape Context Scores-Great Plains Prairie Pothole
Frequency
9
8
7
6
5
4
3
2
1
0
<70
70-79
80-89
90-100
Scores


Landscape Context Scores-Western Great Plains Closed Depression Wetland
Frequency
8
7
6
5
4
3
2
1
0
<70
70-79
80-89
90-100
Scores

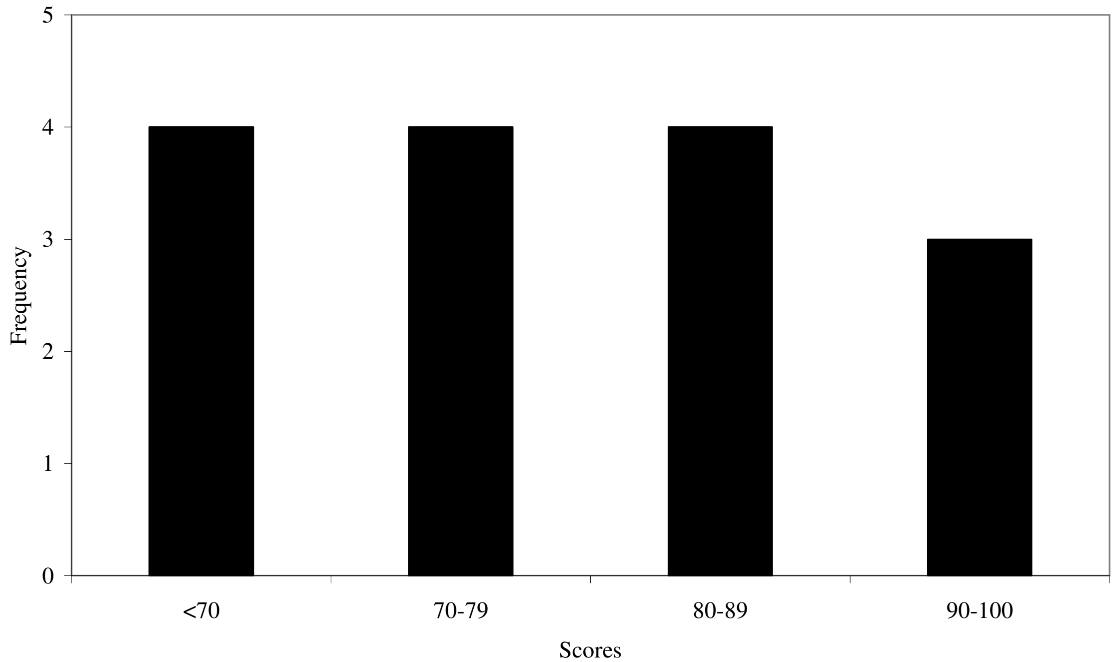
Landscape Context Scores-Western Great Plains Open Freshwater Depression Wetland



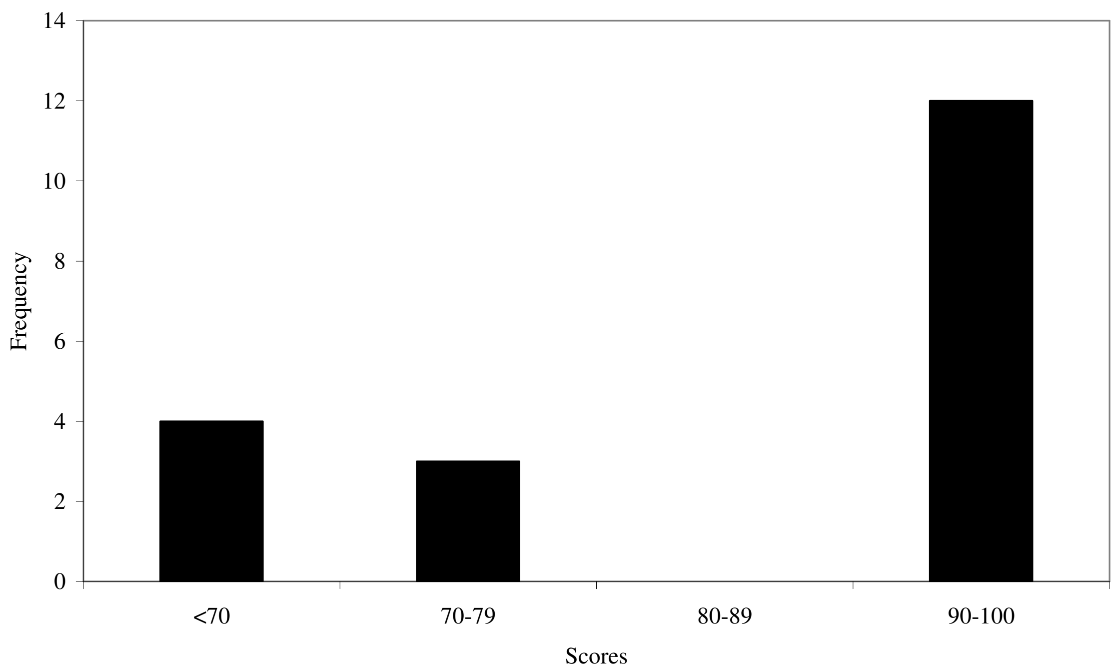
Landscape Context Scores-Western Great Plains Saline Depression Wetland



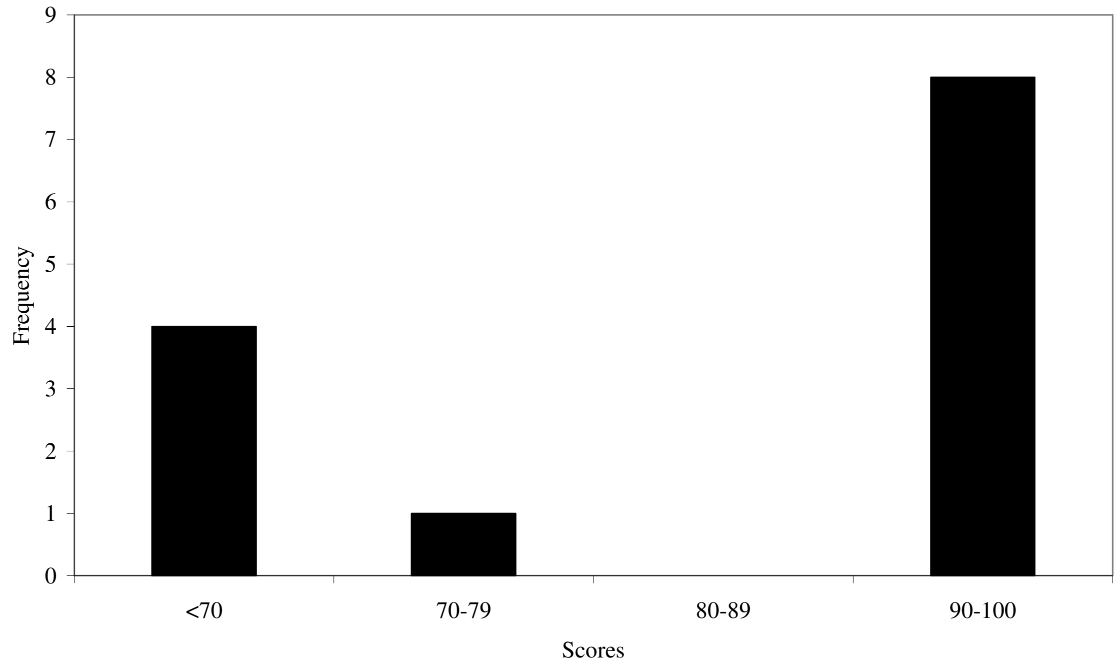
Landscape Context Scores-Northwestern Great Plains Riparian



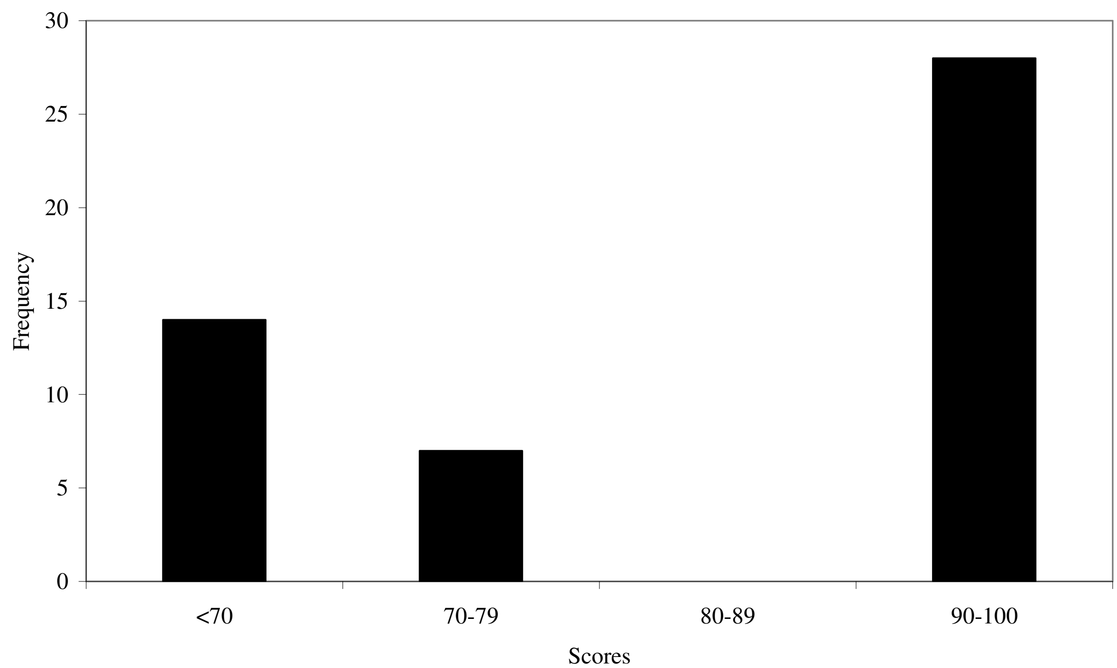
Relative Wetland Size Scores-Great Plains Prairie Pothole



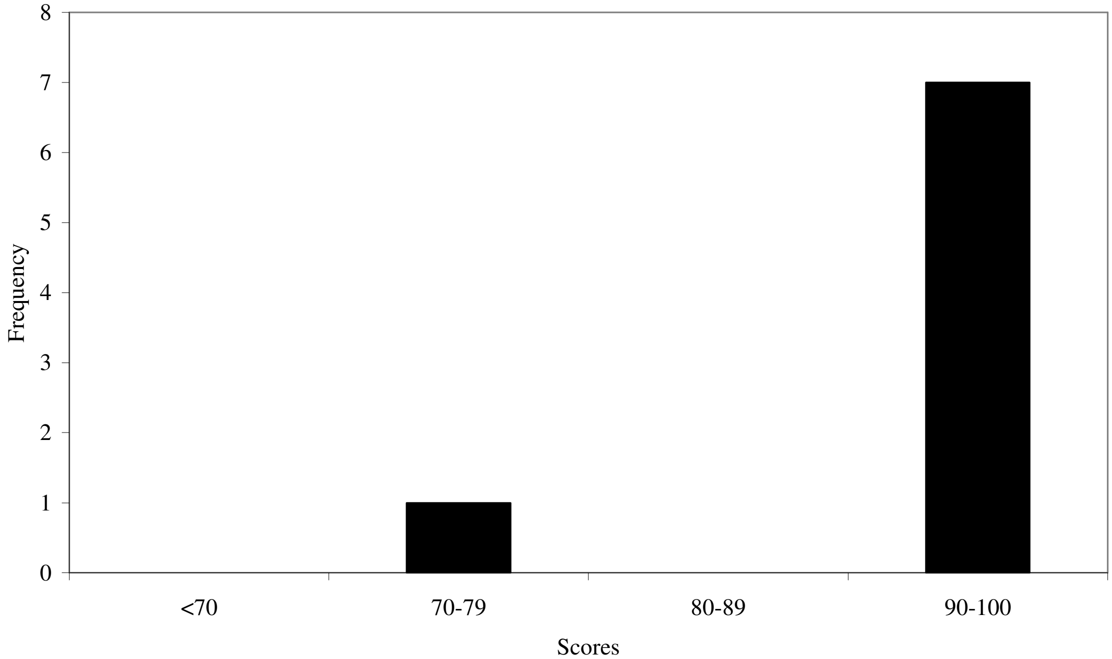
Relative Wetland Size Scores-Western Great Plains Closed Depression Wetland



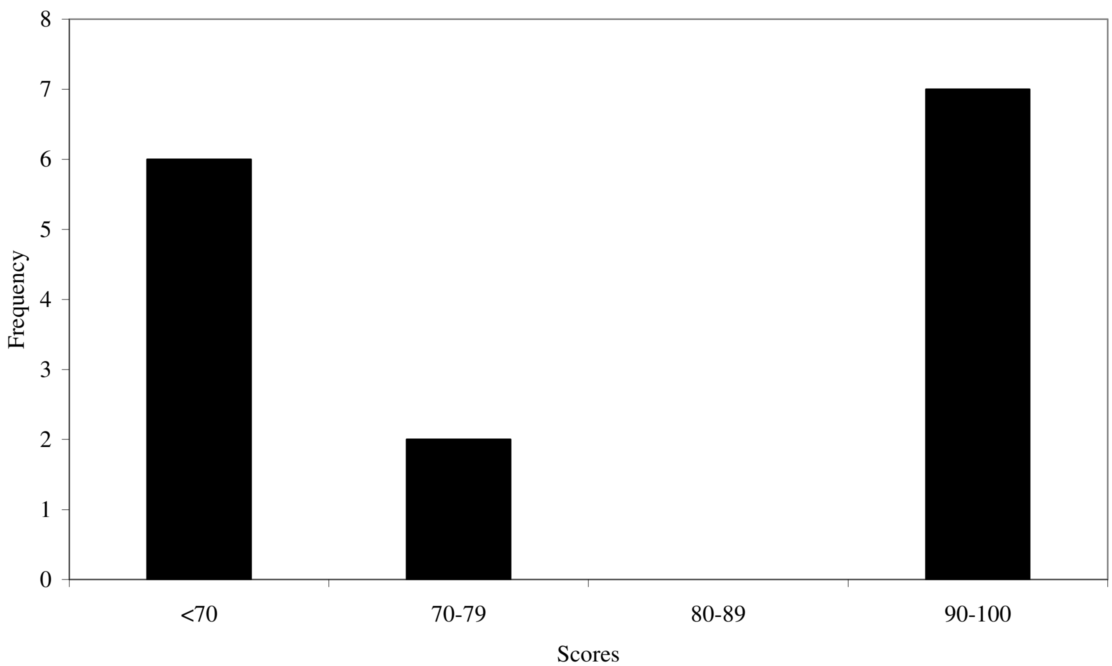
Relative Wetland Size Scores-Western Great Plains Open Freshwater Depression Wetland



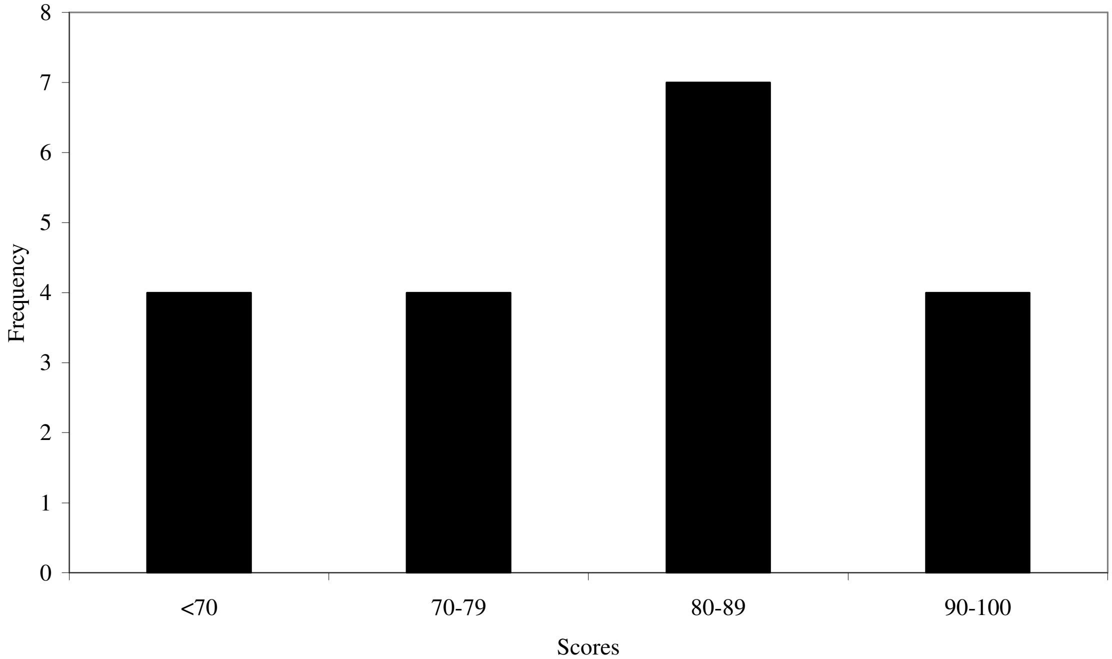
Relative Wetland Size Scores-Western Great Plains Saline Depression Wetland



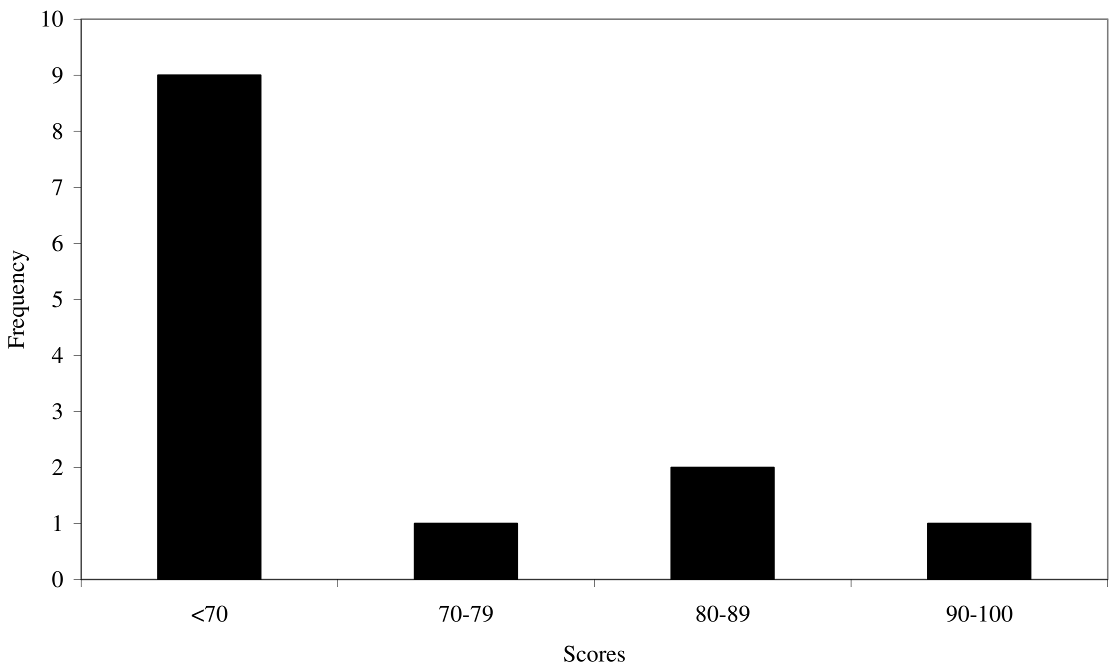
Relative Wetland Size Scores-Northwestern Great Plains Riparian



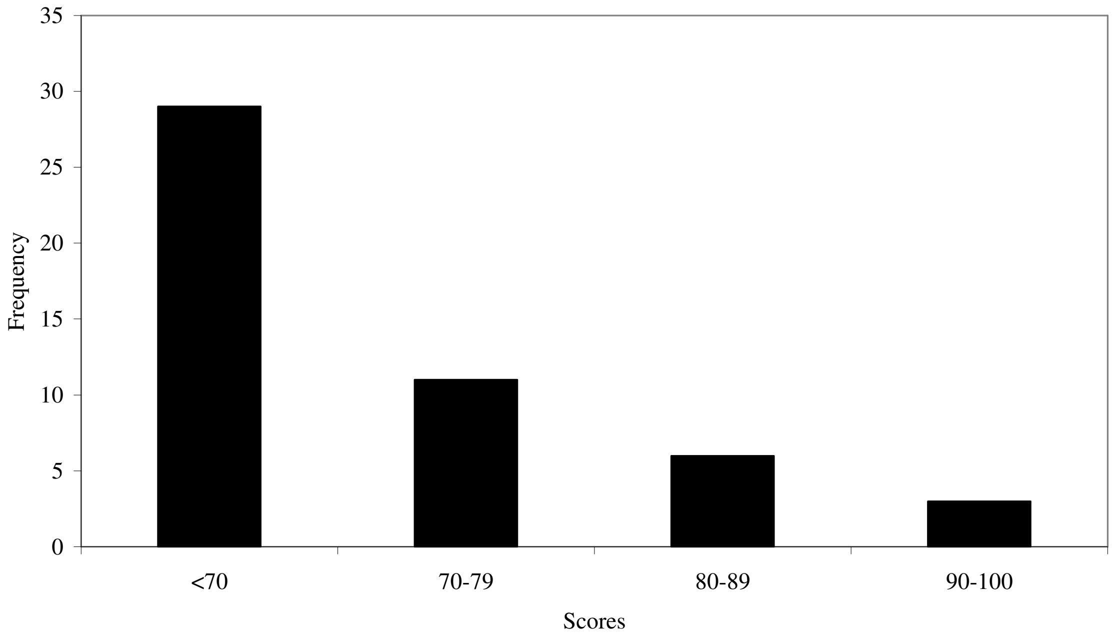
Biotic Composition and Structure Scores-Great Plains Prairie Pothole



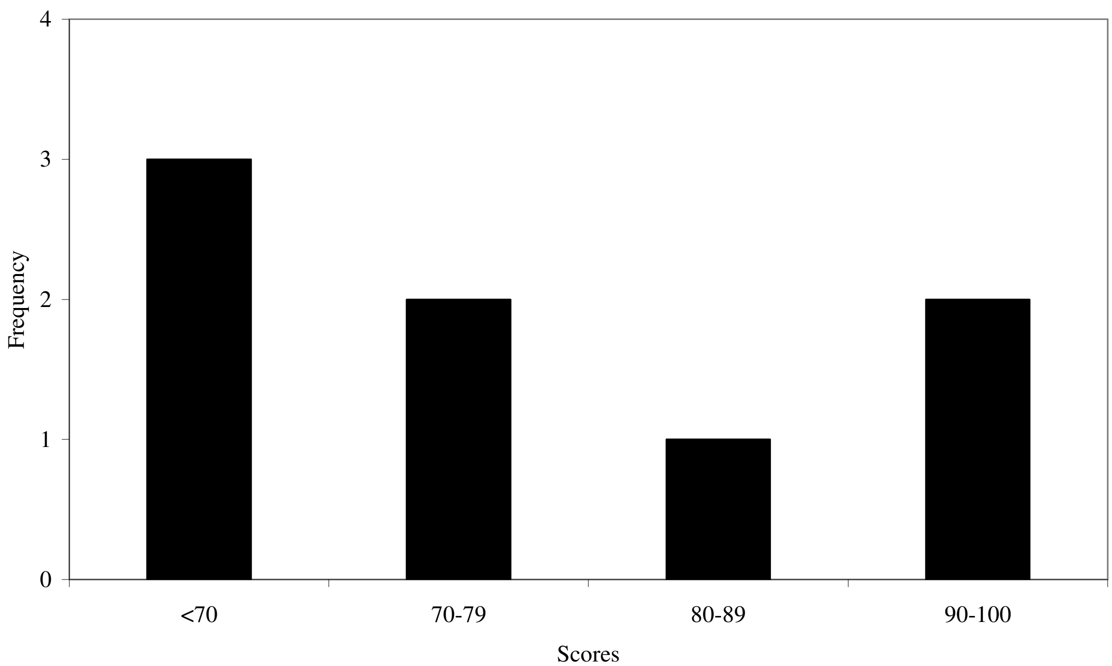
Biotic Composition and Structure Scores-Western Great Plains Closed Depression Wetland



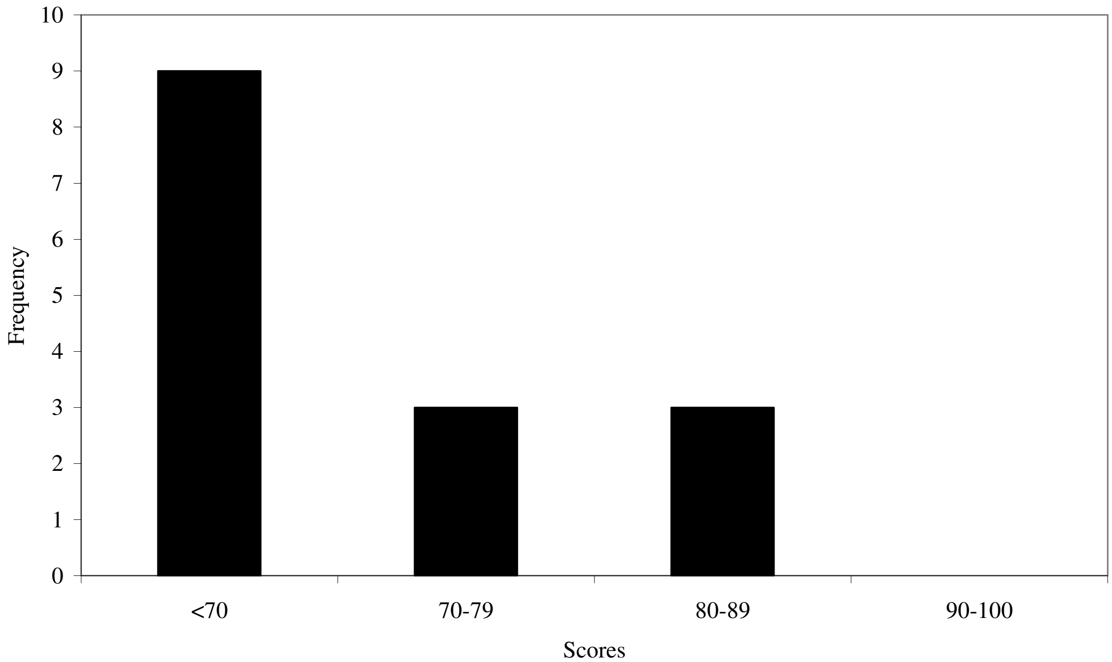
Biotic Composition and Structure Scores-Western Great Plains Open Freshwater Depression Wetland



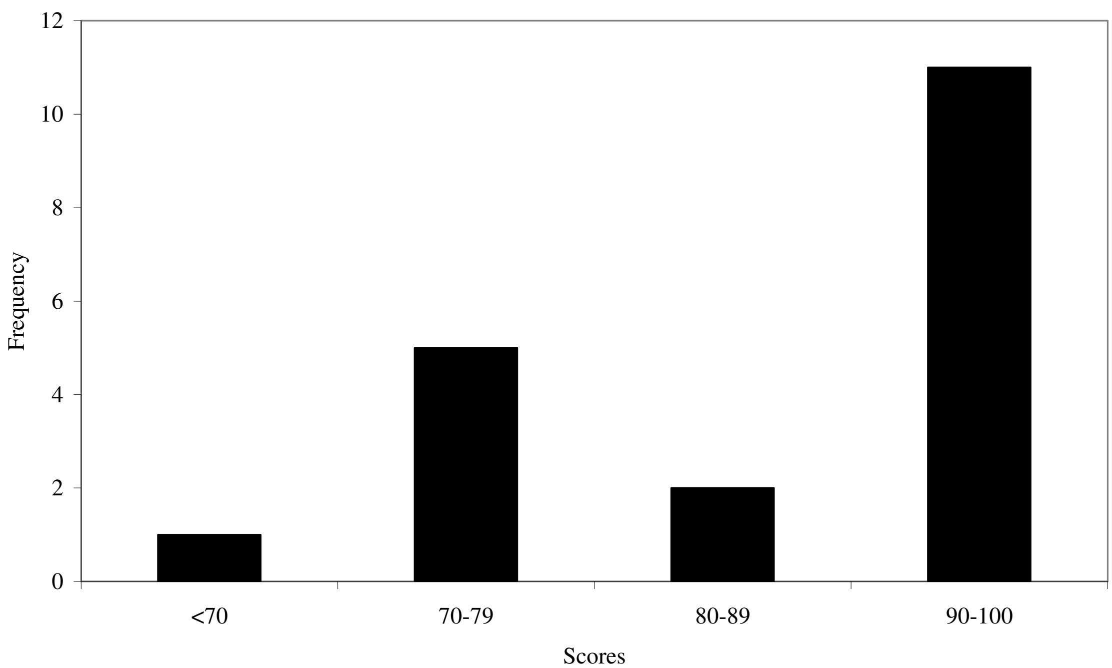
Biotic Composition and Structure Scores-Western Great Plains Saline Depression Wetland



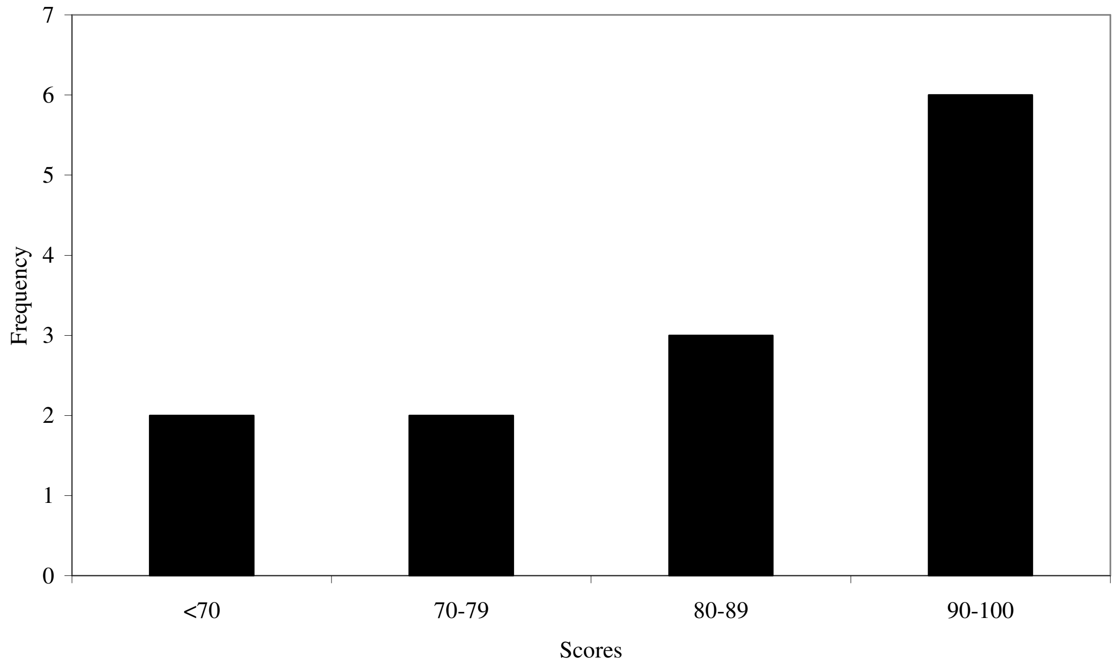
Biotic Composition and Structure Scores-Northwestern Great Plains Riparian



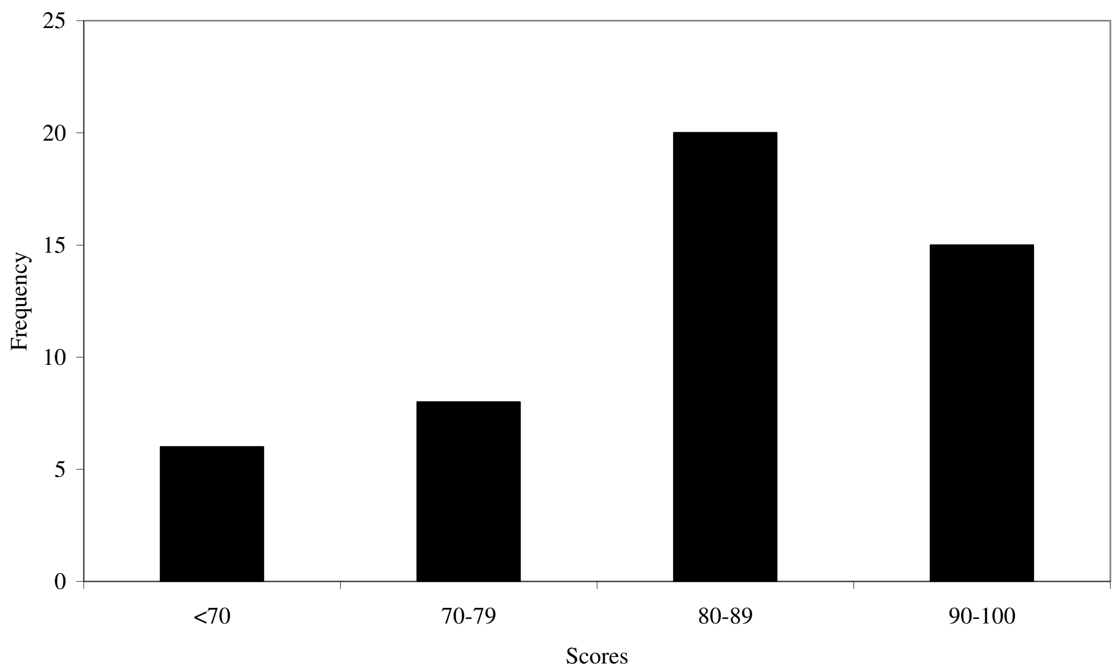
Hydrology Scores-Great Plains Prairie Pothole



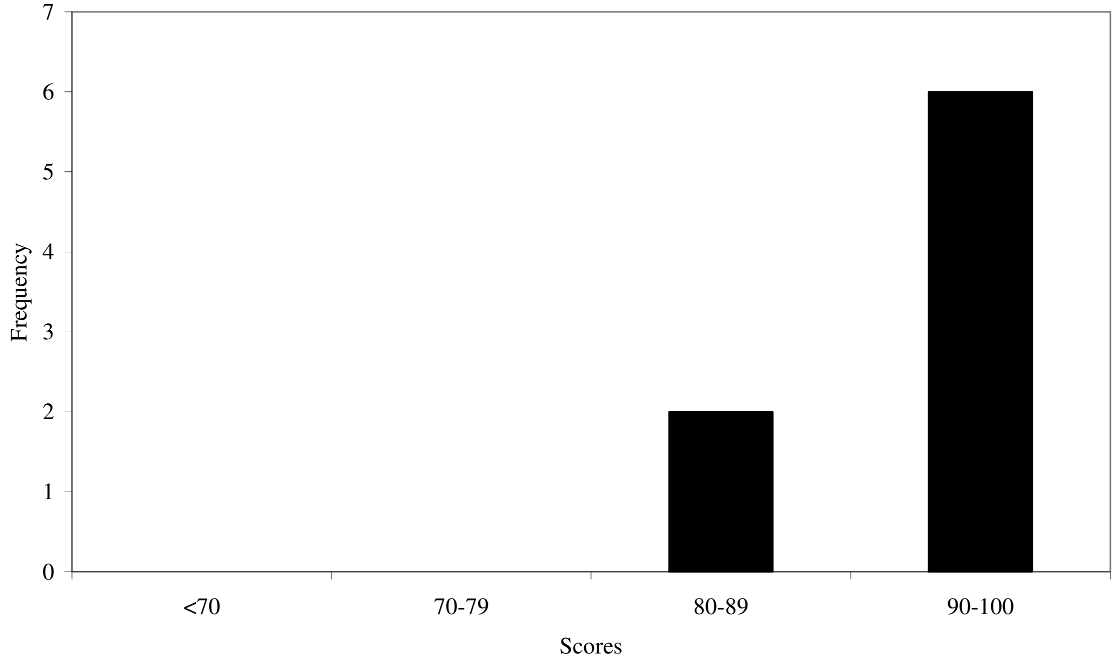
Hydrology Scores-Western Great Plains Closed Depression Wetland



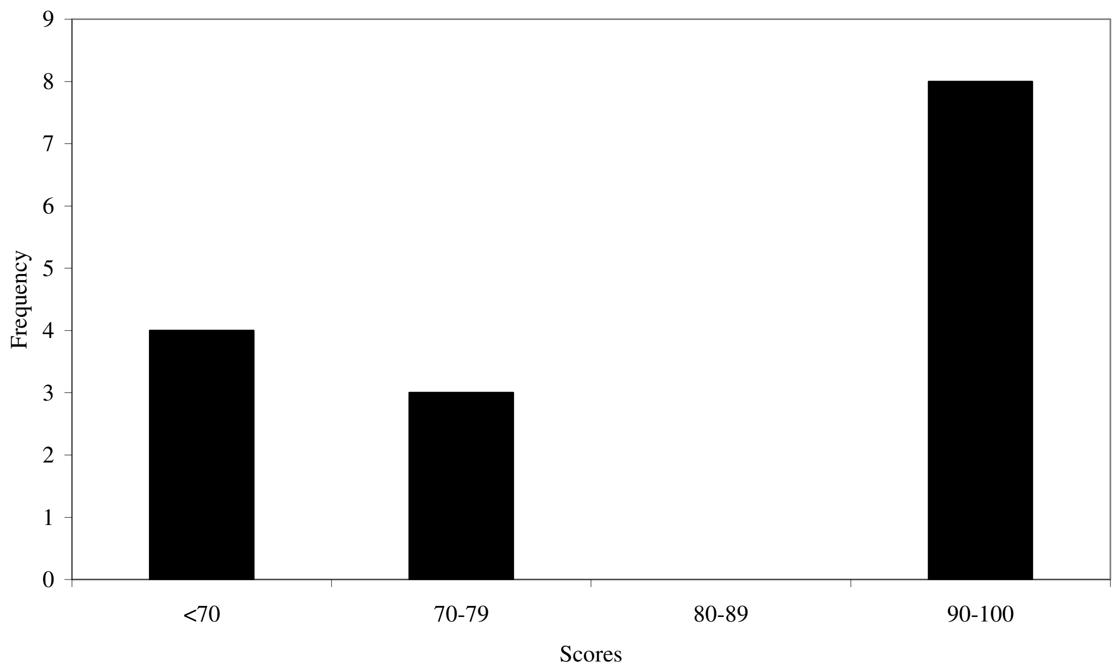
Hydrology Scores-Western Great Plains Open Freshwater Depression Wetland



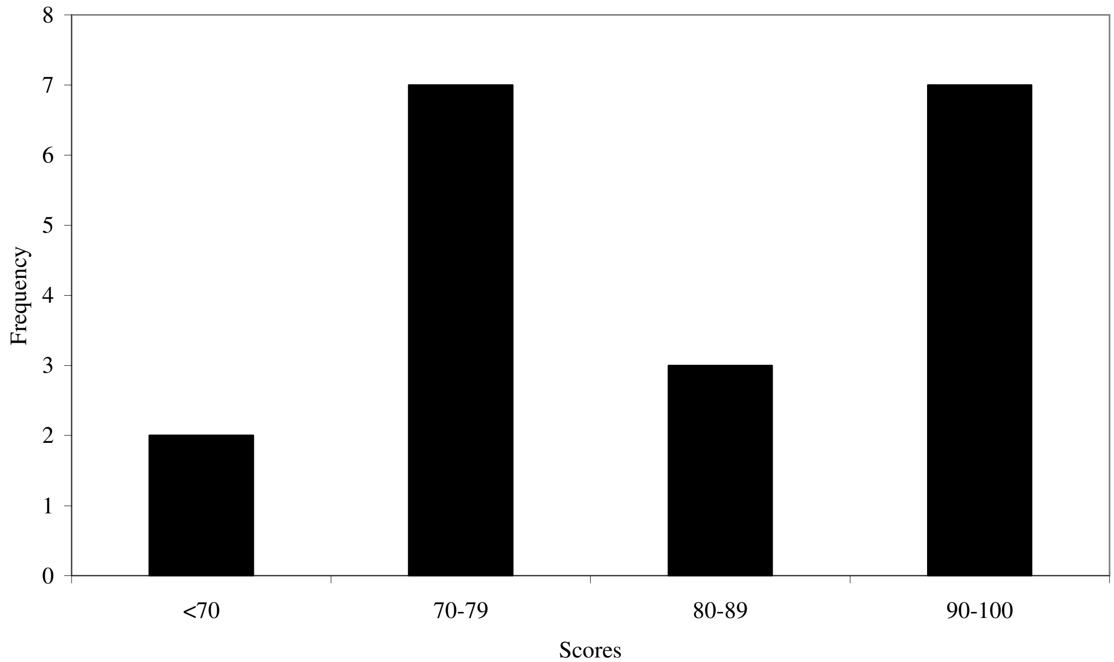
Hydrology Scores-Western Great Plains Saline Depression Wetland



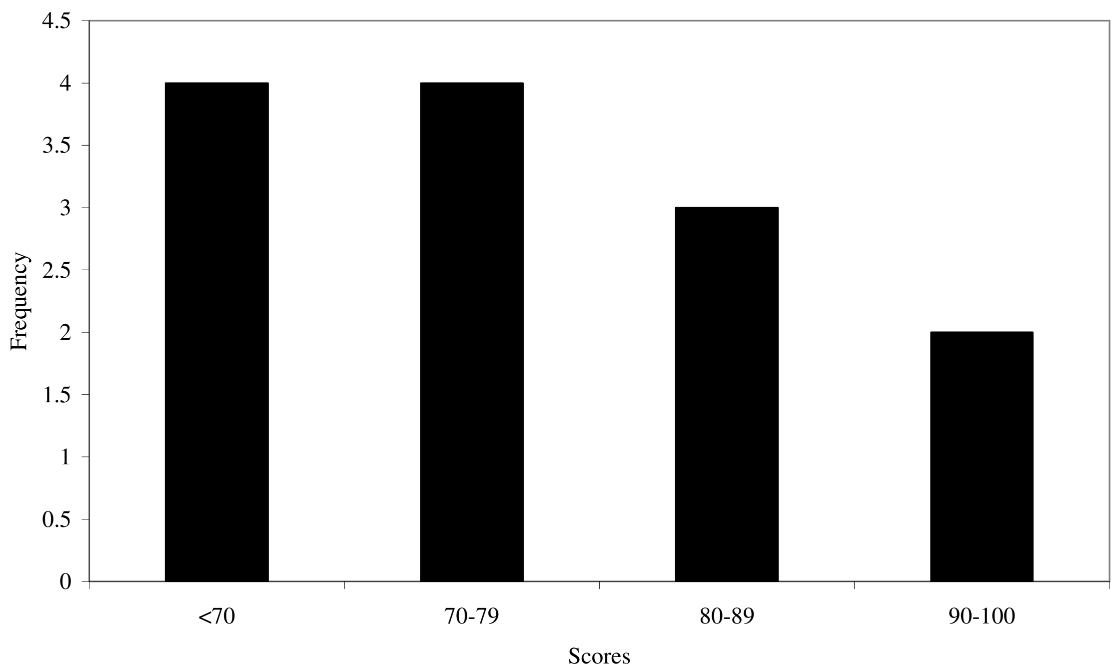
Hydrology Scores-Northwestern Great Plains Riparian



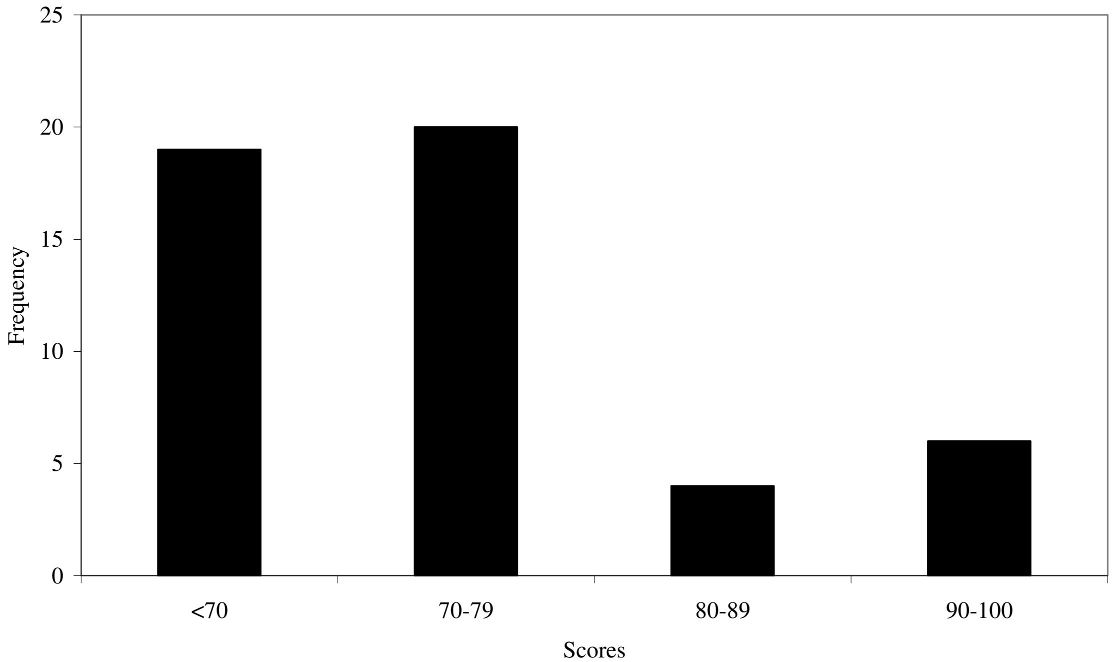
Physicochemical Scores-Great Plains Prairie Pothole



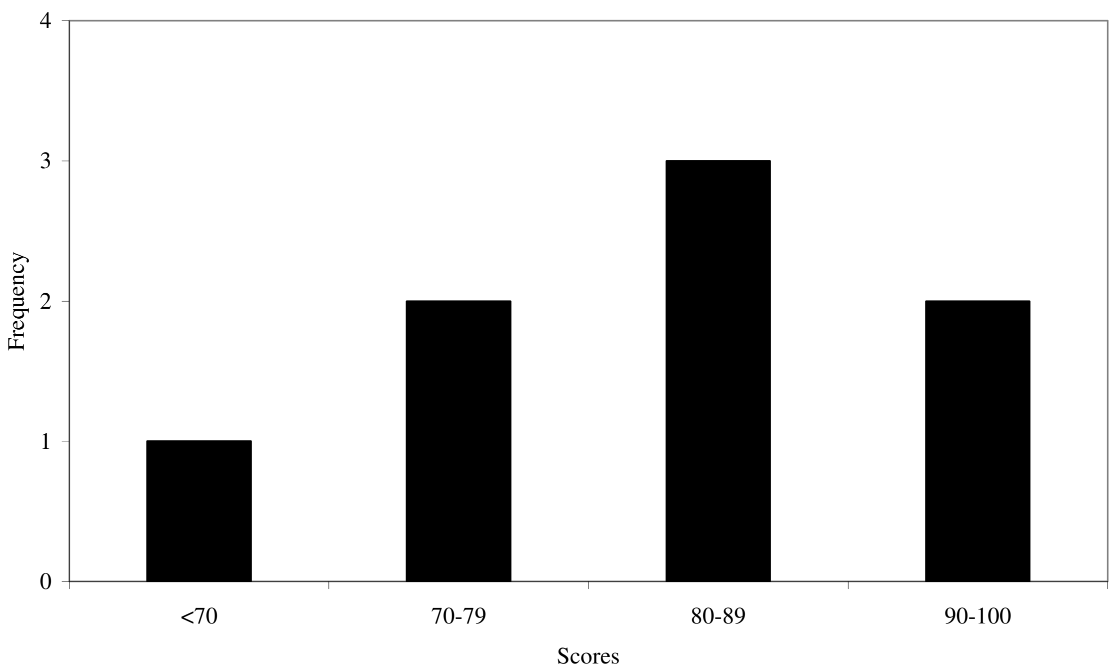
Physicochemical Scores-Western Great Plains Closed Depression Wetland



Physicochemical Scores-Western Great Plains Open Freshwater Depression Wetland



Physicochemical Scores-Western Great Plains Saline Depression Wetland



Physicochemical Scores-Northwestern Great Plains Riparian